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REVISION OF THE NON-COMBED EYED SIPHONAPTERA.

BY KARL JORDAN, PH.D., AND
THE HON. N. C. ROTHSCHILD, M.A., F.L.S.

CONTENTS.

INTRODUCTION.

The importance of certain species of fleas in relation to the epidemiology of plague has been so amply demonstrated (see *Journal of Hygiene*, vols. VI. 1906, p. 426 and VII. 1907, p. 395) that an explanation appears scarcely necessary for our publishing a paper dealing with a revision of the non-pectinated eyed Siphonaptera. With the demonstration that fleas are capable of transmitting plague, their study at once ceased to be the mere hobby of a small group of entomological specialists. An accurate knowledge of fleas, both with regard to their structure and biology, is at present a matter of prime importance to those who concern themselves with the prophylaxis of plague.

The assumption seems justified that the species which is most abundant on rats in those portions of the world where plague is endemic will be the one which is most instrumental in spreading the disease.

In a paper by Rothschild (1906, p. 483[1]) it was stated that the species of flea usually found on rats in tropical and subtropical countries is *Pulex cheopis* Rothsch. When investigating the fleas which occur on any given host it appears to us to be essential to ascertain if there is more than one species associated with the spread of disease in the host, and to demonstrate precisely, in order to avoid confusion, the characters by which the various allied species can be distinguished.

It is obvious that false conclusions will be drawn by investigators who maintain that numerous similar (though in fact specifically distinct) forms are identical. Such observers have usually examined their specimens with eyes untrained for the special line of investigation upon which they have entered, with the result that they deny the existence of differences which are obvious to the specialist.

We shall, therefore, before describing the various species of *Loemopsylla* with which we are acquainted, point out the reasons which guide us in the discrimination of the differences which we consider to be specific and those which we consider to be non-specific.

The criterion of a "species" is a biological one. The fauna of a district consists of a certain number of units, each producing its own kind only; each being independent of the other in that respect; their own organisation only keeping these units apart. Such a unit we call the "species." Each species varies more or less and all individuals composing a species are different from one another. Again a species may be split up into well marked varieties, sometimes with and sometimes without the existence of intergradations. All individual varieties are, nevertheless, specifically identical, standing either in the relation of brothers and sisters or parents and offspring. It is for the specialist to determine in each group which forms are mere varieties of one unit and which forms are species. The ultima ratio is breeding. In a group where breeding from the egg has been carried out, at least in some instances, the systematist knows which differences are specific in these cases and which are not; and it is perfectly legitimate—in fact the only possible course that can be adopted—to determine by analogy the taxonomic value of differences observed in other allied forms. In the case of Siphonaptera we are at all events certain as to the specific distinctness of a number of common species. The flea of the domestic fowl, that of the domestic pigeon, the one from the house martin, and the flea from the sand martin, though formerly considered to be

[1] For literature relating to the transmission of plague by fleas see *Journal of Hygiene*, vol. VI. p. 433 (1906).

identical are now recognised as being perfectly independent of each other. The nests of the sand martin yield no other flea than *Ceratophyllus styx*, while henhouses are infested by *Ceratophyllus gallinae*, which are easy to rear. Rabbit warrens contain quantities of *Spilopsyllus cuniculi*, the insect being sometimes present in very large numbers on a rabbit, the individuals varying to a slight extent. From a careful comparative study of a very large series of specimens of such species, we arrive at a knowledge of the approximate limits of variation. The range of variation not being the same in the various organs, the most important point to ascertain is which organs are variable and which are comparatively constant in such undoubtedly distinct species. The characters here observed to be specific are a guide and a basis of classification in the case of allied forms about the life history of which nothing is at present known.

In the present treatise we are dealing with Pulicidae (*Loemopsylla cheopis* being one of them) which can be recognised by the following characters: the complete absence of a comb (= pecten or ctenidium) from the genal edge of the head as well as from the pronotum, and the presence of a strongly developed eye.

This group of fleas comprises six genera already recognised, namely, *Pulex* L., *Lycopsylla* Rothsch., *Moeopsylla* Rothsch., *Parapsyllus* Enderl., *Rhopalopsyllus* Baker, and *Goniopsyllus* Baker. We are, however, convinced that the division of this group into six genera only is an unnatural grouping. In the present article therefore a classification of these insects based upon a comparison of nearly all the known species has been attempted. This we think is especially desirable as considerable confusion appears to exist regarding the generic position of some of the species. The distinctions between the various species, too, do not appear to us to have been realized by all of those who have studied them. A concise exposition therefore of the generic and specific characters should, we think, be of use to those who have material they wish to name. It should, however, be clearly understood that the genera treated of in this paper are not more closely allied to each other than to some other Siphonaptera which have ctenidia. For instance, *Ctenocephalus erinacei* and *Spilopsyllus cuniculi*, which we exclude from this paper, are more closely allied to *Pulex irritans* than are the members of the American genus *Rhopalopsyllus*, which we shall deal with.

We intended at first to restrict this paper to an exposition of the species closely allied to *Loemopsylla cheopis* (which plays so prominent

a part in relation to plague), but on reflection we thought it would render the paper more useful, if we included also all the other Siphonaptera which have eyes but no comb on the head and pronotum. The scope of this paper has in consequence been considerably widened, but nevertheless we shall give most attention to the genus *Loemopsylla.*

A synopsis of the genera to be discussed in the following pages.

(**I**) Club of the antennae short, distinctly segmented only on the posterior side (Pl. II, fig. 1, 5). Antennal groove closed behind, the genal process separating the antennal groove from the forecoxa (Pl. II, fig. 1, 5, 13). Labial palpus consisting of four segments; tip of rostrum asymmetrical (Pl. II, fig. 8). Hindcoxa with a comb of short spines on the inner side (Pl. I). Fifth tarsal segment with 4 lateral bristles besides the subapical hair (Pl. III, fig. 7). Antepygidial bristle separate from the apical edge of the seventh tergite (Pl. V, fig. 5).

The species which belong to this group are all inhabitants of the Old World, but *Loemopsylla cheopis* has become more or less cosmopolitan, as the range of its hosts —the domestic rats—has increased.

We divide the species into four genera :—

1. Mesosternite very narrow, without internal rod-like incrassation from the insertion of the coxa upwards.....1. Genus: **Pulex.**

2. Frons without tubercle; anterior angle of genal edge produced backwards into a triangular lobe; pronotum longer than metanotum (Pl. II, fig. 1).

2. Genus: **Pariodontis.**

3. Frons with small mesial tubercle near the suture which separates the frons from the occiput; anterior angle of genal edge of head produced downwards into a triangular lobe; pronotum shorter than metanotum (Pl. II, fig. 13).

3. Genus: **Moeopsylla.**

4. Frons without tubercle; anterior angle of genal edge not produced into a triangular lobe; mesosternite with a rod-like internal incrassation from the insertion of the coxa upwards (Pl. I).....4. Genus: **Loemopsylla.**

(**II**) Club of antenna segmented all round, and the antennal groove open behind, the genal process being short (Pl. II, fig. 3, 12). Hindcoxa without a row of short spines on the inside. Labial palpus sharply segmented all round, consisting of 4 to 7 segments, the tip of the last segment being symmetrical (Pl. II, fig. 9). Fifth tarsal segment with 4 lateral bristles, besides a subapical hair. One antepygidial bristle, standing at the edge of the segment, which is sinuate (Pl. VI, fig. 7).

The species are American, with the exception of one, which has been found far south on an island in the Indian Ocean and on an island off the coast of West Australia.

Two genera :—

5. Club of antenna not symmetrical, the proximal segments sloping backwards (Pl. II, fig. 3). Genal process with only one or two bristles.

5. Genus: **Rhopalopsyllus.**

6. Club of antenna symmetrical, the proximal segments not detached on the hinder side and not sloping backwards (Pl. II, fig. 12). Genal process with a number of bristles. .....6. Genus: **Parapsyllus.**

(**III**) Club of antenna segmented all round, symmetrical (Pl. II, fig. 4). Hind-coxa without comb. Fifth tarsal segment with at least 5 lateral bristles, besides the subapical hair (Pl. IV, fig. 2).

The three genera which come under this heading are not at all closely related to one another.

7. Antennal groove open behind, the genal process being short and broad (Pl. II, fig. 4). Abdominal tergites with one row of bristles, except the first tergite, which bears two. Claws of tarsi with basal tooth; first midtarsal segment shorter than second. Two receptacula seminis in ♀.....7. Genus: **Coptopsylla.**

8. Antennal groove open behind. Abdominal tergites with very numerous short bristles besides the long postmedian ones. First midtarsal segment longer than the second. .....8. Genus: **Goniopsyllus.**

9. Antennal groove closed behind. Abdominal tergites with one row of bristles, there being a few additional bristles on the first tergite. Claws of tarsi without distinct basal tooth. Antepygidial bristle absent in both sexes. No stylet in ♀.

9. Genus: **Lycopsylla.**

1. *Genus*: **Pulex** *Linnaeus* (1758).

Pulex, Linnaeus (1758, p. 614, partim, type of name: *irritans*); Geoffroy (1762, p. 615, partim); Fabricius (1775, p. 732, partim); Barbut (1781, p. 329, t. 18, fig. 5, copy of Geoffroy's fig.); Schellenberg (1798, p. 45); Latreille (1809, p. 366, n. 543, partim); Wood (1821, p. 124, partim); Swainson and Shuckard (1840, p. 393, partim); Bouché (1832, p. 503); Newman (1851, p. 143); Haliday (1856, p. 9, t. 1); Kolenati (1859, p. 65); Bielet (1881, p. 6); Boden (1882, p. 70, *Pulex* feeding on larva of a Tineid); Tyrrell (1884, p. 86); Dimmock (1884, p. 186, fleas eaten by earwigs); Blathwayt (1895, p. 345, t. 16); Wagner (1898, pp. 555, 575, partim); Baker (1904, p. 378, partim); Baker (1905, p. 128, partim).

Head. Frons without notch. Antennal groove closed behind, the genal process reaching almost to the lower posterior angle of the occiput. There is a strong internal incrassation from the base of the antennal groove to vertex. The second segment of antenna transverse, bearing several long bristles at the apical edge; club short, round, solid on anterior side, the segmentation being barely indicated on this side, while the first three segments are deeply separated on the hinder side. There are a few very small hairs on the anterior side. Eye large, a little pointed below. Two bristles beneath the eye and a third at the oral edge. The anterior angle of the genal edge projecting somewhat downwards, and usually bearing a small tooth. Mandibles broad, short, and densely serrate. Rostrum shorter than the maxillary palpus,

reaching about halfway down the forecoxa. The labial palpus consists of 4 segments.

Thorax. Thoracic tergites short, each with one row of bristles; no subapical spines on the mesonotum. Prosternum widest close before apex. Mesosternite characteristic, very narrow, its ventral edge strongly oblique, the stigma not being entirely covered; no internal rod-like or cariniform incrassation from the insertion of the coxa to the dorsal edge. Episternum of the metathorax not quite separated from the sternum, the suture being indicated anteriorly only by an internal incrassation.

Abdomen. Convex in both sexes, dorsally as well as ventrally. The first tergite with two rows of bristles, the other tergites with one; the seventh with one long bristle a little before the apical edge. Stigmata large.

Legs. Midcoxa narrow, the internal rod-like incrassation dividing near base. Hindcoxa pear-shaped, long, being widest near base, hairy in front and behind on inner side, and bearing a row or patch of short spines near apex. First fore- and mid-tarsal segment shorter than second.

Modified segments. ♂: 8th tergite with small manubrium as in *Echidnophaga*. Clasper bearing a very large flap, on the inside of which there are two processes forming a kind of claw as in the *Sarcopsyllidae*; manubrium of clasper large, curved. Ninth sternite boomerang-shaped, its upper inner end pointed. Internal wire-like spring of ninth sternite and penis making several coils.—♀: no hairs above the stigma of 8th tergite. Stylet with long apical bristle and a short bristle before apex. Anal sternite truncate, the bristles confined to the apical edge.

This genus contains one species only, parasitic on man. In many respects it is the most specialized of all the *Pulicidae* and resembles in some characters the *Sarcopsyllidae*. The chief character of this insect is the greatly reduced thorax, the mesosternite especially being highly specialized. The pleura of this sternite is narrow and strongly oblique and lacks the internal cariniform incrassation found in other fleas. This incrassation usually extends from the suture of the coxa upwards to the anterior corner of the pleura, but it is absent from *P. irritans* and from some of the *Sarcopsyllidae*. In compensation for this loss the anterior ventral portion of the mesosternite (*i.e.* the sternum) is much strengthened inside. The peculiar structure of the ♂ genitalia separates *irritans* from all allied genera and links it with the *Sarco-*

psyllidae. The three free processes of the clasper are found in several of the old-world genera of the *Pulicidae*, the main characteristic, however, exhibited by *P. irritans* and the *Sarcopsyllidae*, *i.e.* that the second and third processes form a kind of claw, is not found in any of the other species. The genitalia of *P. irritans* are probably of a more primitive type than the genitalia of any other Siphonaptera (see Jordan and Rothschild, 1906, p. 38). *Pulex irritans* exhibits a further distinguishing character in the position of the bristles on the head, the bristle situated in front of the eye in most species being absent in *irritans* and replaced by one below the eye, as is also the case in *Loemopsylla chephrenis*. The hindcoxa—as is the case in some species of the genus *Loemopsylla*—is pear-shaped, but in *Pulex irritans* this coxa can be distinguished from that of any other known flea by bearing a number of hairs situated on the inner surface of the posterior (= meral) portion. A most interesting feature in the morphology of this flea is the presence in a large proportion of specimens of both sexes of a small tooth at the genal edge of the head, slightly behind the lower oral corner. This tooth from its position and structure corresponds to the fifth tooth of the genal comb of *Ctenocephalus canis* and allies. This single small tooth of *P. irritans* (often absent) is the last remnant of the genal comb with which, we think, the ancestral forms of *irritans* were provided. In the case of *Ctenocephalus erinacei* the teeth of both the genal and the prothoracic combs are small in size and few in number and occasionally almost disappear. This fact seems to us to be further evidence that the ancestral forms of *P. irritans* possessed both genal and prothoracic combs.

1. **Pulex irritans** *Linnaeus* (1758).

Pulex, *Puce*, *Floh*, *Flea*, etc., Moschetti (1544); Schwenckfeld (1603, p. 550); Hooke (1665, p. 61, t. 32, ♀); Borrich (1676, p. 185); Charleton (1677, p. 53); Muralto (1682, p. 137); Griendel von Ach (1687, p. 17, fig. 4); Bonanni (1691, fig. 56); Leeuwenhoek (1695, p. 20); Leeuwenhoek (1698, p. 325, fig. 1–20); Cestone (1699, p. 42, fig.); Leeuwenhoek (1706, p. 2311, proboscis); Bonanni (1709, p. 345, t. 377, fig. 49, t. 378, fig. 50–56); Camerarius (1714, p. 71); Joblot (1718, t. 13, fig. 6); Vallisnieri (1733, t. 25, fig. 1); Frisch (1734, p. 8); Cuno (1734); Bertolotto (1834); Albin (1736, p. 69, t. 41, ♀); Linnaeus (1744, p. 96); Adams (1743–46, t. 27); Rösel (1749, p. 10, t. 4, fig. 26, ♂, partim, good descr. of life-hist. of dog-flea); Linnaeus (1748, p. 67); Baker (1753, t. 13, fig. 6); Linnaeus (1756, p. 73); Kniphof (1759, § 15); Ledermüller (1761, p. 41, t. 20, ♀, metamorphosis); Geoffroy (1762, p. 616, t. 20, fig. 4, ♀); Weiss (1762, p. 340); Yeats (1773, p. 243); Degeer (1778, p. 7, t. 1, fig. 1); Martynn (1785); Ray (1788, p. 483); Latreille (1796, p. 172); Fitzgerald (18—?, p. 268,

fig.) ; Hadfield (1867, p. 837 ; on sandy shore, South India, in great abundance ; this species ?).

Pulex vulgaris Raius (1710, p. 7) ; Linnaeus (1730, p. 78).

Pulex ater Linnaeus (1746, p. 342, n. 1171).

Pulex irritans Linnaeus (1758, p. 614, n. 1, partim) ; Linnaeus (1760, p. 614, n. 1, partim); Sulzer (1761, p. 62, n. 65, t. 22, fig. 146 *f*); Linnaeus (1761, p. 479, n. 1965, partim) ; Scopoli (1763, p. 386, n. 1055, partim) ; Linnaeus (1768, p. 1021, n. 1, partim) ; Bourgeois (1769) ; Fuessly (1775, p. 59, n. 1175) ; Müller (1775, p. 1040, partim) ; Fabricius (1775, p. 732, n. 1, partim) ; Sulzer (1776, p. 242, t. 29, fig. 6 *e*, partim) ; Müller (1776, p. 182, n. 2208) ; Schrank (1781, p. 509, n. 1040, partim) ; Fabricius (1781, p. 381, n. 1, partim) ; Fabricius (1787, p. 314, n. 1, partim) ; Amoreux (1789, pp. 103 and 268) ; Roemer (1789, p. 33, n. 5, t. 39, fig. 6 *e*) ; Villiers (1789, p. 42, n. 1, partim, literature) ; Gmelin (1790, p. 2923, n. 1, partim) ; Fabricius (1794, p. 209, n. 1, partim) ; Shaw and Nodder (1794, t. 178, text nec figures) ; Jördens (1801, p. 41, t. 6, fig. 17, 21, 29, partim, literature) ; Sibly (1802, p. 431, partim, general account of structure and habits) ; Stewenson (1802, p. 232, partim) ; Walckenaer (1802, p. 353, n. 1, partim) ; Schrank (1804, p. 194, n. 2630, partim) ; Shaw (1806, p. 456, t. 122, ♂ nec ♀, partim) ; Wilhelm (1811, p. 304, t. 38, partim) ; Leach (1815, p. 126, "there are a vast number of species which have been confounded with *P. irritans*") ; Lamarck (1816, p. 334, partim) ; Savigny (1816, p. 27) ; Samouelle (1819, p. 234) ; Defrance (1824, p. 440, partim, metamorphosis) ; Guérin (1825, p. 244) ; Kirby and Spence (1826, p. 471, t. 7, fig. 8) ; Stephens (1829, p. 328) ; Bouché (1835, p. 147, t. 4, fig. 1) ; Thon and Reichenbach (1838, p. 469, t. 131, fig. 1 *a*–*r*, ♂, ♀, metamorphosis) ; Lucas (1839, p. 393, t. 621, fig. 7) ; Blanchard (1840, p. 633, n. 1) ; Westwood (1840, p. 492) ; Dujardin (1843, t. 15) ; Gervais (1844, p. 365) ; Lucas (1849, p. 624) ; Agassiz (1855, p. 414) ; Walker (1856, p. 2, n. 1) ; Maitland (1857, p. 310) ; Dallas (1857, p. 381, fig.) ; Kolenati (1859, p. 65) ; Kolenati (1863, p. 31, n. 4, t. 1, fig. 2) ; Schenkling (1864, p. 693) ; Streubel (1866) ; Barton (1866, p. 316, in great abundance at Ventnor) ; Dufour (1861, p. 255, cocoon) ; Furlonge (1870, p. 189) ; Cooke (1871, p. 98) ; Furlonge (1872, p. 12) ; Ritsema (1873, p. 94, Holland) ; Ritsema (1874, p. 76) ; Wood (1876, p. 594, fig. 69, 2) ; Taschenberg (1880, p. 64, n. 4, t. 1, fig. 4) ; Ritsema (1881, p. 81, Holland, also on cat) ; Scott (1882, p. 9) ; Kraepelin (1884) ; Bergh (1885, pp. 1–6, fig. 25–29, larvae on skin of a woman) ; Packard (1889, p. 389) ; Raillet (1890) ; Smith (1894, p. 38) ; Packard (1894, p. 330, fig. 16) ; Baker (1895, pp. 65 and 67) ; Anonymous (1895, p. 142) ; Perez (1895, p. 238) ; Meinert (1896, p. 182) ; Osborn (1896, p. 147, fig. 80) ; Jourdain (1899, p. 204, "syringostome") ; Sharp (1899, p. 525) ; Oudemans (1900, p. 596, fig. 344, 1) ; Hilger (1901) ; Froggatt (1901, p. 539, fig. A, ♀) ; Wagner (1902, p. 129) ; Wahlgren (1903, p. 185, Australia, Tenerife, Sweden) ; Kohaut (1903, p. 33, t. 3, fig. 1–5, Hungary) ; Tirabosehi (1904, p. 246, fig. A, ♀, fig. 14, ♂) ; Baker (1904, p. 379) ; Baker (1905 *a*, p. 129) ; Meissner (1905, p. 68) ; Jordan and Rothschild (1906, fig. B, E) ; Tirabosehi (1907, p. 580).

pulex irritans Latreille (1802, p. 577, t. 12, fig. 1, 2) ; Latreille (1805, p. 411).

Pulex hominis Dugès (1832, p. 163).

Pulex simulans Baker (1895, pp. 65 and 67, Texas, off *Didelphys virginiana*); Webster (1904, p. 244).

Pulex irritans, var. *dugesi* Baker (1899, p. 37, Mexico, off *Spermophilus*).

Pulex irritans var. *simulans* Baker (1904, pp. 379 and 457, occurrence on *Didelphys* accidental).

Pulex dugesi Baker (1904, p. 379); Baker (1905, p. 129).

Linné recognised two species of fleas only, *Pulex irritans*, which he diagnosed as *P. proboscide corpore breviori*, in contradistinction to the "chigoe," *Pulex penetrans*, of which he says *P. proboscide corporis longitudine*. Linné's *P. irritans* comprised various very distinct species of flea, such as those found on the rabbit and dog, in addition to the human flea, the true *P. irritans*. Leach, Bouché, Taschenberg and other authors have properly restricted the name *irritans* to the flea parasitic on man, the names *vulgaris*, *ater* and *hominis* of Raius, Linné and Dugès being treated as synonyms. The nearest allies of this species which are found on various animals are all inhabitants of the Old World. The fleas found in America are only distantly related to *P. irritans*. It may therefore be concluded that the present species originated from the Old World stock of Siphonaptera. Our knowledge of the variation and the present and former distribution of this insect is extremely meagre. Nevertheless, there are some points to which attention may with advantage be drawn. The insect is practically cosmopolitan, or, rather, has become cosmopolitan; specimens identical with European *irritans* are found almost everywhere. This was probably not the case prior to the introduction of the systems of intercommunication between all parts of the globe such as have been created in more recent periods. The tropical countries of the eastern hemisphere do not appear to be inhabited by *P. irritans* except where European settlements exist, or, at least, where intercourse with Europeans goes on. Ports, apparently, are everywhere infested by this parasite. We have failed to find any definite records of fleas in books on travel published in the early part of the nineteenth century. Although travellers in the tropics of Africa and Asia frequently complain of the abundance of lice on the natives in their huts, yet fleas do not seem to have been observed.

If it is a fact, however, that the tropical countries of the Old World were originally devoid of *Pulex irritans*, the reasons for the absence of the insect in question are worth considering. Two causes, of a biological character, may conduce to the absence of a species from any particular district. On the one hand the conditions of life may not

have been suitable, while on the other the species may have been debarred from reaching the district by a mechanical barrier of some sort or another.

The absence of *Pulex irritans* from the oases of the Sahara and from the Haussa countries south of the Sahara appears to be a well-established fact. The German explorers Nachtigall and Rollfs definitely state that fleas are absent from these countries, their remarks being corroborated by Dr E. Hartert, who also failed to find fleas in the Haussa countries, though lice were plentiful. The presence of lice would demonstrate that the habits of the natives would permit fleas to thrive, and it is therefore not unlikely that the soil and climate are unsuitable to fleas in these regions of the earth. These countries, moreover, have for many years been in communication with localities where *Pulex irritans* is known to abound. On the other hand the climate and soil of some districts of the Ethiopian region appear admirably suited to the human flea. Anderson (1856, p. 20), when starting on his expedition in 1850 from Walfisch Bay to Lake N'gami, found "myriads" of fleas in a deserted house formerly inhabited by a trader and situated some three miles inland. This statement corroborates what other observers have recorded, namely, that the flea propagates in deserted dwellings, the adult insect not requiring food to enable it to reproduce its species, at least for some time. An observation of a similar character is recorded by Euting (1896, p. 11). On an expedition from Damascus inland, Euting visited a deserted village and found his clothes on leaving it literally covered with fleas. These fleas, he says, appeared in the deserted dark rooms of the stone buildings and were apparently benumbed and without strength from their long fast.

In North, South and East Africa where there are European settlements, *Pulex irritans* appears to thrive well, attacking not only Europeans but also the natives and wild and domesticated animals. Should this parasite have formerly been absent from these countries, this fact can only be explained by the assumption of the existence of some geographical barrier, or that those tribes of men who came from the north and penetrated southwards into Africa lacked the flea. In the Oriental Region similar phenomena to those stated exist in respect to the distribution of this insect. In those parts of the East where European colonies exist and where free intercourse between Europeans and Orientals takes place, *P. irritans* is well established and appears to thrive, but it is not known whether this was the case among purely native populations prior to the advent of European traders and settlers.

The division of mankind into various races, many of them as distinct as the various species of some genus among other mammals, would lead one to expect that a corresponding differentiation would have taken place among the fleas parasitic on them; and that the human flea would now consist of a number of different races each peculiar to its particular human host. Some development of this nature in fact appears to obtain in at least one instance. Dr Carl Baker (1899, p. 37) described a flea found by Dr Dugès in West Mexico (Guanajuato) on *Citellus macrourus*. This insect Dr Baker considered at first to be a variety of *Pulex irritans*, calling it *Pulex irritans* var. *dugesi*, but later he treated it as a distinct species. We have two examples of this *dugesi*, for which we are indebted to Dr Baker, and possess also both sexes of the same form taken off Mexican Indians at Tabasco, which we received from the late Dr Buller. The differences between these Mexican *dugesi* and the true *Pulex irritans* are slight, but, nevertheless, fairly constant. The specimens are smaller in size, the rostrum (labial palpi) is longer, and the large flap of the ♂ clasper is less rounded at the apex. From an examination of our series of *Pulex irritans* from various South American countries, we find that a number of ♀ examples found on *Conepatus* in Bolivia agree with *dugesi* in respect to the length of the rostrum, but are not inferior in size to the true *irritans*. Other examples from Peru, Chile, Argentina, Paraguay and Brazil, taken in houses and on various mammals, do not differ from typical European *irritans*. The occurrence of a slightly different race of *Pulex irritans* in Mexico and Bolivia, and possibly in the intermediate countries, both on the natives and on mammals, raises two interesting points, first, whether *Pulex irritans* originated as a flea found on mammals and then adopted man as its host, or if it developed to what it now is on becoming a parasite of man. In Europe and Central Asia this flea is essentially a parasite of man, occurring only occasionally on other warm-blooded creatures. The same may be the case in other countries, the frequent occurrence of this insect on mammals in America being possibly explained by the closer connection between human dwellings and wild and semi-domesticated beasts. Dirty and deserted huts frequented by small mammals may also induce the human flea to propagate more freely. As we have pointed out the imagines of the human flea can exist a long time without food, while the larvae, as opposed to being parasitic, feed on all kinds of dirt. In respect to the second point mentioned above, namely, whether the present species has undergone modifications since becoming a parasite

of the human race, many speculations could be indulged in. If the "Indians" inhabiting Mexico (and presumably those of other countries of South and Central America) have a special race of *Pulex irritans*, it is obvious that the parasite has either developed into this special race after the Indians came to America, or that they were from the beginning infested by this special race of *Pulex irritans* and not by the ordinary form of *P. irritans*, when they came to America, possibly from Asia. If the latter surmise should be correct then this race of flea may still exist in the original country whence these Indians came.

The individual variation in the specimens of *Pulex irritans* is slight and refers especially to the number of bristles situated on the sclerites of the thorax and on the legs. The most prominent variation is that of the bristles of the femora and of the short spines on the inner side of the hindcoxa. These spines are sometimes but few in number, while again they may be numerous, the variation in respect to the number of these spines in our series of mounted specimens being from 6 to 14.

We have specimens of *Pulex irritans* from various places in Europe, off man and badger[1]; Malcoci, Rumania, off fox and *Putorius putorius*; Rio de Oro, N. W. Africa, off *Gerbillus riggenbachi*; Mogador, Morocco, off *Vulpes niloticus*; Hadgine, Taurus, off dog; Adana, Asia Minor, off cat and *Canis aureus*.

Cairo, Egypt, off *Canis zerda* and *Erinaceus auritus*; Akaki, Abyssinia, off man; Ginir, Abyssinia, off *Canis* spec.; Berbera, N. E. Africa, off dog; Dairoli, Abyssinia, off dog; Sidimun, Somaliland, off *Herpestes gracilis*; Deelfontein, Cape Colony, off *Felis caracal* and *Tinamus* spec.; Kingwilliamstown; Benguella, Angola, off *Canis* spec.; Island of St Thomé, Bay of Benin, off a sea-bird.

Yokohama, off dog, cat, and in a house; Kiu-Shiu, Japan, off man; Bombay, off man; Lhassia, Assam, off dog; Gippsland, Victoria, off *Echidna hystrix*; Paramatta, N. S. Wales, off man; Western Australia.

Alberta, Canada, off *Lynx* and *Vulpes velox*; Frontera, Tabasco, Mexico (= *dugesi* Baker), off natives; Belize, British Honduras, off man; Peru, in houses; Pampa Olliga, Bolivia, off *Conipates arequipae*; Choro, Bolivia, off *Conipates churensis*; Sapucay, Paraguay; Temuco, Chile, off man and dog; Valparaiso, Chile, in a house, in sand, and off *Canis griseus*.

[1] In England *P. irritans* is an undoubted parasite of the badger (*Meles taxus*), from freshly captured wild examples of which animal taken near Reading and Hastings we have secured series of this insect. *P. irritans* occurs occasionally on rats and mice in houses and ships.

2. *Genus:* **Pariodontis** *gen. nov.*

Head. Frons without tubercle (Pl. II, fig. 1). Genal edge produced at anterior angle into a long curved tooth. Antennal cavity closed. Second segment of antenna transverse, bearing a row of long hairs, which reach beyond the club in ♀; club globular, a little longer in ♂ than in ♀, anteriorly solid, but the lines of separation of the central and distal segments distinctly marked, especially in ♂; proximal segments of club free on hinder side. Internal incrassation from base of antennal groove upwards not very distinct in ♀. Eye round; usually a small bristle in front of it, a second beneath it, and a third above oral edge. Mandible rather broad, densely serrate at apex. Labial palpus consisting of 4 segments.

Thorax. Tergites with one row of bristles; no spines before apex of mesonotum. Pronotum longer than mesonotum (Pl. II, fig. 1), and this longer than metanotum. Epimerum of mesothorax oblique, the stigma being partially uncovered. Episternum of metathorax large, separated from the sternum. Bristles of thorax and abdomen stout. Prosternum widest before apex.

Abdomen. Tergites with one row of bristles; seventh tergite bearing one long bristle before the apical edge. Stigmata large.

Legs. Internal rod-like incrassation of midcoxa dividing above the centre. Hindcoxa with comb of short spines on inner side. Ventral surface of hindfemur evenly convex. First fore- and midtarsal segment shorter than the second. Fifth tarsal segment considerably dilated towards apex.

Modified segments. Modified segments of the same type as in *Loemopsylla.*

This genus also, like *Pulex,* contains but one species, which is found apparently all over Africa on *Hystrix cristatus.*

The genus *Pariodontis* is undoubtedly allied to *Pulex* and *Loemopsylla. Pariodontis riggenbachi,* however, is so distinct from *irritans* and *cheopis* that it demands a special genus.

In the non-pectinated eyed *Pulicidae,* with the exception of the present genus, all three thoracic tergites, or at least the pro- and mesonotum, are short, and show a distinct tendency to become more and more reduced in length as specialisation continues.

In *P. riggenbachi,* on the other hand, the prothorax is longer than in any other member of the family *Pulicidae,* and the mesonotum also is not reduced. The long thorax may be an ancestral character, but

the pronotum possibly has secondarily become longer than it originally was.

Pariodontis exhibits the extreme development as regards the extension of the tergites of the thorax, while the *Sarcopsyllidae*, on the other hand, have the tergites of the thorax reduced to narrow strips, *P. irritans* and *L. cheopis* (and allies) representing intermediate phyletic stages.

The *Sarcopsyllidae*, though differing so markedly from *Pariodontis* in the development of the tergites of the thorax, have a character which is not found in *Pulex* and its other near allies, but is present in the porcupine flea, this being the curved tooth (projecting back- and downwards) into which the lower oral corner of the mouth is prolonged. This hook is present in all the *Sarcopsyllidae*, but in the other families is absent, except in the genera *Pariodontis*, *Moeopsylla* and *Lycopsylla*. This character has probably been acquired independently in these different genera, serving the same purpose as the genal comb of other fleas, namely, to prevent hairs getting into the joint between the head and the prosternite when the parasite is passing through the fur of its host. In other respects *P. riggenbachi* is closely allied to the genus *Pulex*, as well as to *Loemopsylla*, but resembles *Loemopsylla* in the structure of the male genitalia. The male genitalia of *Pariodontis* in fact show the same specialised form as in *Loemopsylla* and differ markedly from the male genitalia of *P. irritans*.

(1) **Pariodontis riggenbachi** *Rothsch.* (1904).

(Pl. II, fig. 1.)

♂ ♀, *Pulex riggenbachi* Rothschild (1904, p. 611, n. 7, t. 8, figs. 19, 20, t. 9, fig. 24, Cape Colony and Morocco, name-type from Cape Colony).

The first specimens of this large species were sent to us by W. Riggenbach, who collected them off *Hystrix cristatus* in Morocco in 1900. Since then we have received the insect from other parts of Africa also, the host being in every instance the same.

Mogador, Morocco, November 1904, and Mazagan, Morocco, collected by W. Riggenbach.

Deelfontein, Cape Colony, July 1902; C. H. B. Grant.

Mangona R., Bihé, Angola, January 1904; Dr W. J. Ansorge.

3. *Genus:* **Moeopsylla** *Rothsch.* (1908).

Moeopsylla Rothschild (1908, p. 3).

Very closely allied to *Loemopsylla* and *Pariodontis*, but differs in the following characters:

Head. Frons with a minute tubercle situated close to the suture which separates the frons from the occiput. The genal edge dilated into a tooth as in the *Sarcopsyllidae*, *Lycopsylla*, and *Pariodontis* (Pl. II, fig. 13). The segmentation of the rostrum distinct only on the anterior side.

Thorax. Bristles of the pronotum nearer to the base than to the apex. Metanotum much longer than the mesonotum. Mesosternite narrow, the internal rod-like incrassation, which extends from the insertion of the coxa upwards, ending at the anterior margin of the sternite instead of at the dorsal margin (Pl. II, fig. 13).

Legs. Hindcoxa with a patch (not a row) of very numerous short spines on the inner surface. Basal tooth of the claws very small.

One species from Africa.

(1) **Moeopsylla sjoestedti** *Rothsch.* (1908).

(Pl. II, fig. 13.)

Moeopsylla sjoestedti Rothsch. (1908, p. 3, t. 1, figs. 1—4).

Professor Y. Sjoestedt found a small series of both sexes of this species on *Phacochoerus africanus* in the Massaisteppe, German East Africa, on the 9th October 1905.

4. *Genus:* **Loemopsylla** *gen. nov.*

Head. Frons without a notch or tubercle (Pl. I). Genal process almost completely closing the antennal groove, separating it from the prosternum and being pointed behind. Antenna different in the sexes, the first segment being long in the ♂ and short in the ♀; the second, transverse segment bearing a number of long bristles at the apical edge. The first segment of the club compressed and leaf-shaped; the globular or slightly elongate club appearing solid on the anterior side, the incisions between the segments being hardly at all indicated, while on the hinder side the first two or three segments are deeply separated from one another (Pl. II, fig. 5). On the anterior side of the club there are from two to five very short hairs. Antennal groove in ♀ not

extending to vertex, the internal incrassation from the groove upwards being vestigial or absent. Eye round. One bristle beneath the eye, a second at the oral edge, and a third, often small, in front of the eye. Labial palpus consisting of four segments.

Thorax. One row of bristles on each tergite. On mesonotum no spines between the row of bristles and the apical edge. No small teeth at the edge of the metanotum. Epimerum of the mesothorax oblique, not completely covering the stigma, the suture between epimerum and sternum distinct. Prosterum widest behind (Pl. I).

Abdomen. Convex above and below in both sexes. No small teeth at the apical edges of the tergites, except the first, which bears sometimes two teeth. Seventh tergite with one long apical bristle either on a tubercle, placed away from the apical edge (Pl. VI, figs. 1—4), or, as only in ♂ of *L. scopulifer*, on a long cone (Pl. V, fig. 1).

Legs. Internal rod-like incrassation of the midcoxa forked near the base. Hindcoxa always with comb of small spines on the inner side (Pl. I). Mid- and hind-femora with a row of bristles on the inner side. First fore- and midtarsal segment shorter than the second (Pl. III, figs. 4—6, 8).

Modified segments. ♂. Clasper with two or three small processes; manubrium narrow; upper internal portion of the ninth sternite not very sharply defined (Pl. IV, figs. 6—12).—♀. The stylet bearing, besides the long apical bristle, a short bristle situated in a notch before the apex.

Distribution. Africa and Central Asia, one species (*cheopis*) apparently in all warm countries, being distributed with rats.

Type of name: *cheopis* Rothsch.

Many of the species of this genus differ in size, but they all conform to one type in outline. The thorax being short and the abdomen convex above and below, the species of *Loemopsylla* are compact in aspect, resembling in this respect several other Pulicidae, for instance, *Spilopsyllus cuniculi*, *Rhopalopsyllus australis*, *Ctenocephalus erinacei*, and others. The characters however by which all the species of *Loemopsylla* are distinguished from other fleas are sufficiently trenchant, we think, to render it impossible not to recognise which species belong to this genus and which do not. The most obvious of these distinguishing characters of *Loemopsylla* are the four-segmented labial palpus, the closed antennal groove, the anteriorly solid antennal club, the division of the pleura of the mesosternite by a suture into a sternal and a meral sclerite, the position of the dorsal apical bristle of the seventh abdominal tergite remote

from the edge of the segment, the presence of short spines on the inner surface of the hindcoxa, the division of the rod-like incrassation inside the midcoxa taking place near the base, and the structure of the modified abdominal segments. By observing these characteristics, confusion with other genera is easily avoided.

The species are more numerous in *Loemopsylla* than in the allied genera, or it is perhaps safer to say, more species have become known. Most of these the junior author of the present paper collected himself in Egypt and the Egyptian Soudan. The genus is essentially African, being generally found on desert mammals, one of the species (*L. cheopis*) having become cosmopolitan with its hosts, while three others are only known from Central Asia. They are essentially fleas of rodents, *L. cheopis* being especially often found on rats. As fleas leave the host when it dies, and take to another host, they may become the bearers of germs and hence the means of the spread of infectious diseases, one of the rat-fleas, *L. cheopis*, being the carrier of the plague-germ from rat to rat and from rat to man, and another species, *L. cleopatrae*, also being the means of the spread of disease. A special interest therefore attaches to the study of these insects, and we have accordingly thought it desirable to give here a general outline of their morphology, before proceeding to state the chief characteristics by which the various species of *Loemopsylla* can be recognised. A comparison moreover of the morphological characters of *Loemopsylla* with the other fleas will show clearly the relationship in which this genus stands to other genera.

As we have said above, the compactness of the body is partly due to a reduction in length of the thoracical segments. This reduction has not spread to the head, the capsule of which is large when compared with the thorax. The head being the bearer of the piercing and sucking organs which require a supply of strong muscles, there must be room in the caputal capsule for these organs and their retractors and extensors. We can therefore hardly expect to find the head reduced to any great extent in the fleas which have well developed piercing organs. These organs, consisting of the upper lip (labrum)[1] and the two mandibles, are slenderer and longer in *Loemopsylla* than in *Pulex irritans*, agreeing on the whole with those of the American non-combed eyed fleas. The slender type of mandible is doubtless more ancestral than the broad and heavily serrate type. The latter obtains in all *Sarcopsyllidae* and *Spilopsyllus cuniculi*, as well as in *Pulex irritans*, and to a less extent

[1] According to Kraepelin and Heymons, whose opinion we believe to be correct, other authors call the organ epipharynx.

in *Ctenocephalus erinacei.* Now, the species with the broadest and most heavily serrate mandibles are stationary parasites, fixing themselves firmly in the skin of the host by means of the piercing organs. As the stationary mode of living is without doubt a secondary development, we may accept the broad mandibles to be the result of this change in habits, the mandibles (at least in these closely allied *Pulicidae*) having developed a new function, to assist the insect in retaining its hold as well as to pierce the skin. *Pulex irritans,* however, is a very active insect and by no means stationary.

The width of its mandibles and their strong serration therefore cannot be explained in the way indicated, unless we assume that the ancestral *P. irritans* was a comparatively stationary insect when it adopted man as host. This assumption, however, does not appear to be satisfactory, since it is hardly likely that a stationary parasite should become active again, there being no sufficient reason for this regression to a former state of habits, stationary ectoparasites thriving very well on man. We think, on the contrary, that the strong piercing organs of *P. irritans* were acquired after man had become the host of the insect, the naked skin and the garment covering it rendering the claws of the legs insufficient for keeping the insect steady when sucking, the strengthening of the mandibles, moreover, preventing them from being easily injured. The upper lip also is strong in *P. irritans* and the stationary fleas mentioned, bearing along the anterior edge a number of obtuse teeth. These teeth are present in all fleas, but are often very few in number, being restricted to the apex of the organ. The species of *Loemopsylla* agree with *Pulex irritans* in the armature of the upper lip, except that the teeth are less prominent and fewer in number, while the American non-combed eyed fleas have only two or three such teeth, placed near the apex of the upper lip.

The piercing organs, when at rest, are retracted and the external portion is encased in a tube (= rostrum) formed by the two labial palpi, which are situated at the apex of the short non-divided labium. The number of segments composing the labial palpus as far as we know varies in the *Siphonaptera* from 2 to 17. In most fleas, however, the labial palpus consists of five segments. This appears to be the original state of development, the palpus with more and the one with less segments being a derivation from the normal five-jointed type. The rostrum is not a piercing organ like that of bugs and flies. The two palpi separate, when the mandibles and upper lip, which are interlocked to form a tube, penetrate the skin of the host, lying flat right and left on the skin, or

protruding upwards when the head is embedded in it, as is the case in the *Sarcopsyllidae* (Jordan and Rothschild, 1906, p. 27). The labial palpi therefore require to be flexible and this is attained by segmentation or by a reduction in chitinization. The latter development obtains in the *Sarcopsyllidae*, all species of which family have a very pale, weak, soft rostrum. The necessary flexibility of a prolonged and strongly chitinized rostrum as it is found in various fleas (*Vermipsylla*, *Macropsylla*, etc.) is obtained by greater segmentation. The species of *Loemopsylla*, *Pulex* and *Pariodontis* and the combed fleas *Ctenocephalus*, *Hoplopsyllus*, *Spilopsyllus*, and a few forms provisionally placed in *Ceratophyllus*, as well as a number of eyeless fleas, have four segments in the labial palpus. All the American non-combed eyed *Pulicidae*, however, with one exception, have at least five segments in the labial palpus, the same being also the case in the Transcaspian species *lamellifer* Wagn., which is in other respects also closely allied to the American forms. The reduction in the number of the segments of the rostrum is not always accompanied by a shortening of the organ. The rostrum of *Hoplopsyllus glacialis*, *Loemopsylla longispinus* and others, with four labial palpal segments, is longer than the rostrum of some fleas in which the labial palpus has five segments. The reduction does not take place from the distal end, the apical segment often remaining very long in the 4-segmented labial palpus. The reduction is not effected by the loss of a segment, but the disappearance of an incision, two segments being fused to form one. As the segments bear bristles at the apical edge, an intermediate stage of development between a 4- and a 5-segmented palpus would be a 4-segmented palpus with one of the segments bearing a bristle on each side in or near the centre. Such a labial palpus may exist, but we have not yet observed it. We think it likely that in the 4-segmented palpus the second segment has become fused with the first.

The bristles at the extreme tip of the rostrum are apparently sensory in character like those at the apex of the maxillary palpus. The insect is probably using them to test the skin of the host prior to puncturing it, at least so it appears when a hungry flea is placed on the hand or arm. These "testing" bristles of the rostrum differ both in number and size in the various groups of fleas; and as the variation within each group is but slight, they afford characteristics which are valuable for classification. There are apparently never more than six such bristles at the tip of each labial palpus, this being, it would seem, the normal or ancestral number, three bristles being placed on each side at the apical edge of the end-segment. This number is found in

the majority of fleas, the tip of the segment being more or less symmetrical (Pl. II, fig. 9). In other forms one or two bristles on one or both sides are lost, while in the *Sarcopsyllidae* all these bristles are absent. The non-combed fleas from the Old World, allied to *Pulex*, differ widely in respect to these bristles from those found in America. In *Rhopalopsyllus* and the allied genera from America described hereafter the end of the rostrum is practically symmetrical with six bristles at the tip of each end-segment (Pl. II, fig. 9). These *Pulicidae*, therefore, have preserved the tip of the rostrum in a generalized state of development. On the other hand, in the Old World non-combed fleas, with the exception of *lamellifer*, the end-segment of each labial palpus is obliquely truncate, being asymmetrical and bearing only three bristles at the edge (Pl. II, figs. 8, 10, 11). The same very striking characteristic obtains also in *Ctenocephalus* and *Spilopsyllus*, which are close allies of *Pulex* and *Loemopsylla*.

Some further peculiarities which separate the Old World allies of *Pulex* from the New World genera are the shape and structure of the prae-antennal or frontal portion of the caputal capsule. A large number of fleas possess the so-called frontal tubercle or notch in the centre of the frons, but nearer to the mouth than to the antenna. This tubercle is especially well developed in nearly all the species of *Ceratophyllus* and allied genera, being sometimes inserted in a groove. It attains its greatest development in *Listropsylla agrippinae* Rothsch. (1904 *a*, p. 634), and in this species is heart-shaped (or rather, like the "spade" in cards) and projects from a groove. The real nature of this organ is at present unknown, though presumably an organ of sense, and its homology is also uncertain. The organ is suggestive of the egg-breaker of the larva, but is probably a new acquirement, being perhaps neither a modification of some organ possessed by the ancestral Siphonaptera (*ocellus*, for instance), nor a remnant from the larval stage. The simple tubercle of many *Ceratophyllus* may not however be homologous to the tubercle placed in a groove, but in any case the organ is of considerable taxonomic value in those *Pulicidae* we are here dealing with. This tubercle situated in a groove is well developed in all the American forms, but is not met with in any species of the Old World genera *Pulex*, *Pariodontis*, *Moeopsylla* and *Loemopsylla*. In *Moeopsylla* only there is a minute tubercle, which is not however situated in a groove and is placed much more dorsal than in the American species.

A second characteristic feature in the prae-antennal portion of the head of *Loemopsylla* and its allies obtains in the development of the

genal area, which is the portion of head situated beneath the eye and extending from the mouth to the antennal groove. This so-called genal process is in the various Siphonaptera either prolonged so far backwards as to meet the hind-edge of the post-antennal portion of the head and therefore closing the antennal groove behind, or it is short, being widely separated from the occipital (or posterior) portion of the head by the antennal groove, the latter therefore being open behind. The closed antennal groove (Pl. II, figs. 1, 5, 13) is found in *Pulex, Pariodontis, Moeopsylla* and *Loemopsylla* and a number of combed fleas, while the American non-combed allies of *Pulex* have the antennal groove open (Pl. II, figs. 3, 12), which is also the case in *Coptopsylla lamellifer* from Transcaspia (Pl. II, fig. 4). Two stages therefore in the phyletic development of the head can be observed in this group of fleas, and the question presents itself which of them is the earlier and which the later stage; or in other words, had the ancestors of these insects an open antennal groove or a closed one? From whatever order of insects the Siphonaptera may be a derivative, the antennal groove is a specialization and hence also the division of the head from the crown to the lower posterior corner. Further, the closed antennal groove is not merely a lateral impression surrounded by the solid skeleton of the caputal capsule, but the groove is closed, because the genal process of the prae-antennal portion of the head reaches to the post-antennal portion, there being a suture (or even a small gap underneath the genal process) which separates the apex of the genal process from the occiput. This suture (or gap) proves that there was here at one time a disconnection. The same conclusion is arrived at if we consider the antenna itself. The closed antennal groove of *Pulex, Loemopsylla* and allies corresponds to a reduction in the antennae. The *Pulicidae* with long and well-segmented antennae have also an open antennal groove extending on to the prosternite. The complete segmentation of the antennal club being regarded as an earlier phyletic stage than the short club, which is segmented on one side only, necessitates the conclusion that similarly the closed antennal groove is a derivation from the open groove, the closing of the groove being perhaps a consequence of the reduction in the size of the antenna.

The sexes of *Loemopsylla* differ considerably in the upward extension of the antennal groove, as they do in most other Siphonaptera. The groove reaches nearly to the vertex of the head in the ♂, there being, moreover, an internal incrassation from the groove upwards, this being the suture, or the remnant of it, which in insects generally limits the

frons and is situated between the antennae. In the ♀ the groove does not extend nearly so far dorsad and the internal incrassation is absent or vestigial only. The antennae themselves show a corresponding differenee in the sexes, being longer in the ♂ than in the ♀, as is generally the ease in fleas. The first segment especially is very much longer in the ♂ of *Loemopsylla* than in the ♀, the differenee between the sexes being mueh slighter in the Amerieaη forms. The seeond segment is transverse and bears in both sexes a row of long bristles at the apieal edge. These bristles are longer in the ♀ than in the ♂. The elub is somewhat shorter in the ♀ than in the ♂. The nine segments eomposing it are separated on the posterior side[1] by the segmental ineisions, the ineisions being especially deep between the first four segments. The anterior side of the club is solid, only three eentral ineisions being faintly indieated. On the inner surfaee the elub bears very numerous minute hairs in the ♂ only. The bristles of the head are likewise not quite the same in the sexes, inasmuch as there is in the ♂ along the hinder side of the antennal groove a row of small hairs, whieh is represented in the ♀ by a very few hairs only. These hairs[2] of the ♂ are not plaeed very elose together, the interspaee between every two being at least equal to one-fourth the length of the hairs. In this charaeter the ♂♂ of *Loemopsylla* differ from the Amerieaη *Pulicidae* of the present group of genera, the hairs being very elose together in the ♂♂ of the American forms and also numerous in the ♀♀ (Pl. II, figs. 3, 12). The funetion of these short stiff hairs may be simply proteetive. The antenna is an organ of smell whieh plays an important sexual rôle, inasmueh as it enables the sexes to find eaeh other, and might easily be injured if it were exposed[3], when the flea is gliding through the fur or feathers of the host. The antenna is proteeted by being enelosed in the antennal groove, of whieh the anterior edge often partly projeets over the groove. Possibly the row of short hairs at the posterior side of the groove may proteet the antenna from behind. The hairs, however, may also serve as a kind of comb for eleaning the antenna, inseets generally having some means or other (forelegs, mouth-parts) with whieh they are able to remove dust or dirt from this organ of sense. In *Rhopalopsyllus* they are plaeed on a earina (Pl. II, fig. 3).

The other bristles of the head are praetically alike in the sexes.

[1] "Posterior" when the antenna is lying in the groove.

[2] Dahl (1898, p. 191) calls these bristles the remnants of a faceted eye.

[3] The antennae of ♂ ♂ when in copula are usually exposed; further observations on this point would be interesting.

They are, however, of some morphological interest and frequently offer characters of taxonomic value. The hinder portion of the head (or occiput) bears normally in fleas three rows of bristles, one near the base of the antenna, a second in the centre and a third near the hinder edge of the head. It is interesting to find that these three rows are continued also over the frontal portion of the head (Pl. II, fig. 3). Here the anterior row extends from the maxillary palpus to the base of the antenna, the second row is placed in front of the eye, consisting usually of three long bristles, while the third row, which is absent from most fleas, is situated on the genal process. The three rows divide the head in four sections, corresponding perhaps to the four segments of which the head is composed.

The thorax of the *Siphonaptera* has some very characteristic features. The three segments (pro-, meso- and metathorax) are each quite distinct, while the incision, however, between the pro- and mesothorax is deep, the meso- and metathorax are more closely applied to each other. The thorax therefore in this respect resembles most nearly that of *Coleoptera*, with this difference, that in *Siphonaptera* the hind edge of the mesonotum is similar to the metanotum and overlaps the same, and the metasternite projects farther ventrad than the mesosternite, the two segments not being so closely connected as in *Coleoptera* and *Rhynchota*. Each of the three thoracic tergites of *Siphonaptera* forms a simple half-ring, there being no distinct division —by a suture—into two principal sclerites, a scutellum and a post-scutellum, as in other holometabolous insects. In *Loemopsylla* the tergites are narrow and bear each only one single row of bristles, as is also the case in *Pulex*, *Ctenocephalus*, and some other allied genera (Pl. I). In the ♂ of *Loemopsylla regis*, however, there are dorsally a few hairs in front of this row on the pro- and mesonotum. This single row corresponds to the postmedian row of bristles of other fleas, the bristles of this row being always longer than those of the preceding row or rows. The width of the segments of the thorax varies to a slight extent in *Loemopsylla*, the mesonotum especially being distinctly longer in some species than in others. The comparatively long mesonotum of the heavy-spined *Loemopsylla chephrenis* Rothsch., and the likewise comparatively long metanotum of the long-bristled *Loemopsylla longispinus* Wagn., have only one row of bristles, while in some American allies of *Loemopsylla* these tergites, which have no greater width than in the *Loemopsylla* mentioned, bear two or even three rows of bristles. From this it is obvious that the

loss of bristles in *Loemopsylla* and the allied Old World genera is not a consequence of the reduction of the segments in width, but indicates rather the general tendency towards reduction obtaining in many organs of these Old World Siphonaptera. The pronotum of *Loemopsylla* never bears a comb, nor are there any slender, bristle-like, subapical spines on the mesonotum, nor has the metanotum ever a dentate or serrate apical edge.

The sternites of the thorax, with the exception of the prothorax, have preserved the original main division into an anterior and a posterior portion. The prosternite, as is very often the case in insects, does not show any distinct separation into several sclerites. It bears the coxae at its anterior corner, the whole prosternite therefore being postcoxal. The lateral portion of the prosternite, which is larger, especially in length, than the ventral portion, has in *Loemopsylla* the same shape as in *Pulex*, being widest near its hinder end. It is strongly chitinized beneath, being more or less flattened behind the coxae. The meso- and metasternites on the other hand are ventrally membranaceous from the insertion of the coxae backwards. The prosternite never bears any bristles in *Siphonaptera*, which is remarkable, since the meso- and metasternites have quite a number of bristles on the sides. Above the slanting posterior edge of the prosternite is the first stigma, situated between the prosternite and the protergite and concealed underneath the overlapping edges of these sclerites. In a mounted (cleared) specimen the circular trema of the stigma and the trachea are generally plainly visible (Pl. II, fig. 1).

The mesosternite exhibits a similar characteristic reduction in size and shape as in *Pulex*. There is, however, in *Loemopsylla*, as in the other *Pulicidae*, a rod-like internal incrassation laterally in the mesosternite, extending from the insertion of the coxa upwards and corresponding to the meral suture of other insects, which divides the sternite into an anterior (= sternal) and a posterior (= meral) portion (see diagram, figs. A and B). The meral suture itself is absent from the outer surface of the sternite in *Loemopsylla*. This internal rod-like incrassation is absent from *Pulex* and the *Sarcopsyllidae*. From the insertion of the coxa forwards there is another internal incrassation which corresponds to a suture separating in other insects the sternum from the episternum. The most anterior portion of the mesosternite of *Loemopsylla* is therefore homologous to the sternum, and the triangular portion situated further dorsal homologous to the episternum. The relative position of these two sclerites, which are entirely fused in

Siphonaptera, is best visible in the bat-fleas (*Ischnopsyllus*), in which the sternum is much longer than in the true *Pulicidae*. The posterior portion of the mesosternite, namely, the epimerum, has in *Loemopsylla*

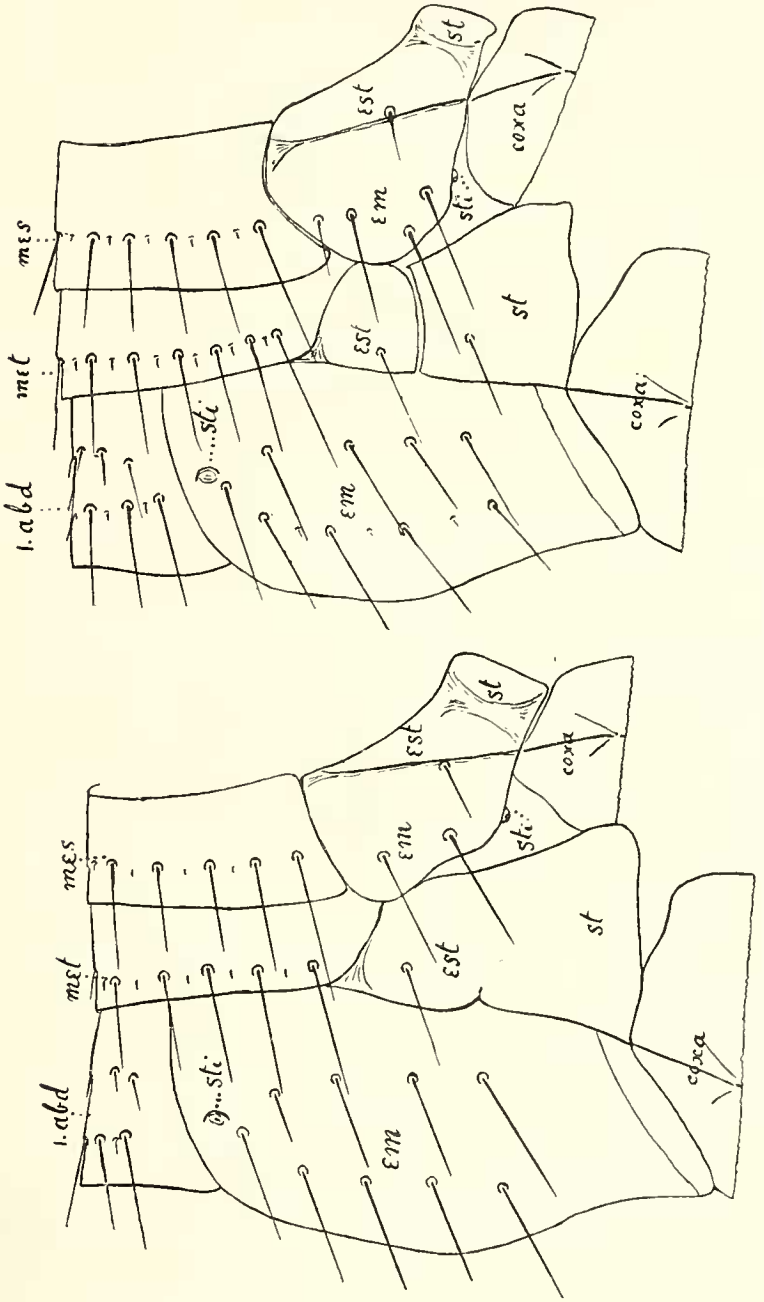

Fig. A.

Fig. B.

Fig. A. Meso- and metathorax of *Loemopsylla pallidus*. Fig. B. The same of *Loemopsylla cheopis*.
mes = mesonotum ; met = metanotum ; st = sternum ; est = episternum ; em = epimerum ;
sti = stigma ; 1. abd = first abdominal tergite.

the same shape as in *Pulex irritans*, being much smaller than in the New World non-combed *Pulicidae*. The ventral posterior edge of this epimerum recedes obliquely upwards, the stigma, which is situated

beneath it, projecting a little below the epimerum. This stigma, or rather the walls of the cavity in which the trachea opens, is nearly globular, appearing in a lateral view to be situated on a short stalk, the whole being cup-shaped (Pl. II, fig. 1, sti). This organ was formerly often mistaken for a remnant of the mesothoracic wing, though the vestige of wings, if there are any vestiges left in any Siphonaptera, should be sought for in the place where the wings of insects are inserted, namely, between the sternite and tergite, *i.e.* dorsally of the epimerum and not ventrally of it. The mesosternite has always some bristles on the side, there being usually one at the internal incrassation, two at the stigma and one further dorsal, some species (for instance *regis* and *chephrenis*) having one or two more bristles.

The metanotum is sometimes shorter, and sometimes longer than the mesonotum in *Loemopsylla*, but the metasternite on the other hand is always larger than the mesosternite, the great development of the metathoracic epimerum being quite a special feature of the Siphonaptera. The metasternite has preserved the original sutures dividing it into three main sclerites, the fusion not having proceeded so far as in the case of the mesosternite. The meral suture is quite plain (see diagram, figs. A and B), and the anterior portion is again clearly divided by a horizontal suture into a sternum which is ventral, and an episternum which is lateral. The episternum is in *Loemopsylla* smaller than the sternum. It varies, however, a good deal, being, for instance, much longer in *L. longispinus* than in the other species of this genus. The most interesting feature in connection with this episternum of *Loemopsylla* is the more or less complete fusion with the sternum which obtains in a number of species, the suture between the two sclerites partially or totally disappearing both externally and internally in several species. In these species, therefore, the metasternite agrees more closely with the mesosternite than in the other species with a separate metathoracic episternum. This specialization we have found, outside the genera which are the subject of this paper, in an American *Ceratophyllus*[1] only. The fusion does not occur in the American non-combed *Pulicidae*, but is found in *Pulex irritans* and to a certain extent in the Old World species *Ctenocephalus erinacei* and *Spilopsyllus cuniculi*. The third sclerite of the metasternite is the epimerum, which extends from the first abdominal tergite downwards to the hindcoxa, its

[1] *Ceratophyllus terinus* Rothsch (1905). In our revision of the *Sarcopsyllidae*, we stated (1906, p. 30) that the epimerum and sternum of the metathorax are fused as in *Ceratophyllus charlottensis*. This was a pen-slip for *C. terinus*.

lower edge covering part of the coxa. This episternum former authors considered to represent the hindwing of other insects, the real homology of this sclerite not occurring to them. Though its position is exactly as in the mesosternite the great size of the epimerum was apparently misleading. In all the genera of *Pulicidae* under discussion the epimerum has a great dorso-ventral extension, corresponding to the great expanse in that direction of the abdomen. The epimerum thus forms a lateral cover to the base of the abdomen replacing the absent sternal plate of the first abdominal segment. At the upper edge of the epimerum there is the third stigma. The epimerum bears in *Loemopsylla* always two rows of bristles[1], the numbers varying often according to species, the females having a few more bristles than the males. The first row is sometimes represented by one bristle only (*e.g. creusae* and *isidis*). There is never an apical or subapical bristle on the epimerum[2].

The abdomen (Pl. I) is strongly rounded dorsally and ventrally in both sexes of *Loemopsylla*, agreeing closely with that of *Pulex irritans*. The ventral curvature of the abdomen is much more marked in the male than in the female, especially anally, the genitalia being directed obliquely upwards. As in *Pulex* and *Ctenocephalus*, the abdomen is short, being more developed in a vertical direction than is the case in the American non-combed *Pulicidae*. The first tergite, which is the longest of all, but does not extend so far downwards as the other tergites, bears in most species of *Loemopsylla* two rows of bristles, the anterior row being sometimes represented by a few bristles only. In two species, however (*L. isidis* and *creusae*), this tergite has but one row of bristles. The tergites of segments 2 to 7 never bear more than one row of bristles, thus differing from the American non-combed *Pulicidae*, which have at least two rows on each segment. These bristles are placed on segments 2 to 6 of *Loemopsylla* a little beyond the centre of the segment, while on the seventh segment the row is situated much nearer the apical margin. In nearly all the species of *Loemopsylla* the row is complete, the most ventral bristle standing beneath the stigma, which is situated near the basal edge of the segment some distance from the row of bristles. The number of

[1] *L. aequisetosus* Enderl. is said to have only four bristles on this sclerite.

[2] On the inside of the epimerum or of the first abdominal tergite or of the meso- or metanotum there are often in mounted specimens the chitinous remnants of muscle-heads. We mention this because Packard (1894, p. 329) considered this patch to consist of *hairs* situated on the *outside*.

bristles is not the same in all the different species, the rows on the central segments containing, for instance, in *regis* about 20 bristles, while there are only about 10 in *pallidus*. The number is most reduced in *L. creusae*. In the male of this species the tergites bear 6 bristles on the two sides together, one placed below the stigma and the others on the back, the intermediate bristles being absent or reduced to minute hairs. The seventh tergite bears in addition to the postmedian series a single subapical bristle which is situated a short distance proximally of the apical edge of the segment (Pl. VI, figs. 1—4), as is the case also in *Pulex, Ctenocephalus, Moeopsylla* and *Pariodontis*, the edge of the segment not being excised as in the other *Pulicidae* inclusive of the American forms allied to *Pulex* and *Loemopsylla* (Pl. VI, fig. 7). In the ♂ of *L. scopulifer* this bristle is placed on a process which projects beyond the edge of the segment (Pl. V, fig. 1).

The sternites of the third to sixth abdominal segments bear in *Loemopsylla* each a ventral row of bristles, there being sometimes a few additional bristles in front of this row on the second and third sternites or only on the third, as for example in *Loemopsylla erilli* and *gerbilli*. The first sternite, which is that of the second segment[1], the first segment having no sternal sclerite in the Siphonaptera, as is also the case in many other insects, overlaps the second tergite, while in the other segments the upper portion is covered by the tergite. This first sternite has in most species of *Loemopsylla* only two ventral bristles, but in the ♀♀ of a few species (*L. longispinus, erilli* and *cheopis*) there are in addition some bristles on the side. The bristles on the sternite of the seventh segment are more numerous than on the preceding segments, there being on this segment a single row, and in some species a few additional hairs placed in front of the row.

[1] In *Journal of Hygiene*, VII. p. 446, there is an article on the morphology of *L. cheopis*, the name of the author of the essay not being stated. In this article the ninth sternite is correctly described, but the author, who apparently is not well acquainted with insect morphology, calls this plate the *seventh* sternite, treating the true seventh sternite as belonging to the sixth segment, the fifth sternite belonging to the fourth segment, and so on. He proceeds to explain this by maiutaining that the basal sternite is that of the first segment and not of the second, it beiug quite erroneous to hold the opinion that the sternite of the first segment is absent. Some elementary knowledge of the composition of the abdomen of other insects and of the development of the segments in the chrysalis, we think, would doubtless have prevented the author from making such an astonishing statement. The opening of the vagina above the ninth sternite is quite the normal situation, the anus being situated between the tenth sternite and the tenth tergite. In the case of the ♂ the author makes a similar mistake. The "clasper" is called the ninth sternite, while it is really the lateral portion of the ninth tergite; and the tenth (or last) sternite has been overlooked altogether.

The eighth to tenth segments are modified, partly for sexual purposes. In the females, in which sex these segments are less complicated than in the males, the eighth tergite is very large, the sternite being reduced to a small elongate sclerite lying in between the ventral edges of the tergite (Pl. V, figs. 7—9). The tergite is much narrower dorsally than at the sides, where it is much dilated, and at the edge of the dorsal portion the large cavity of the stigma is situated. Above this stigma there are no bristles in *Loemopsylla* or only one or two very minute hairs, while the wide lateral portion of the segment bears numerous bristles. The number and position of these bristles are of taxonomic value, being more or less conspicuously different in the various species (Pl. V, figs. 7—9; Pl. VI, figs. 1—4). The sensory plate situated on the ninth tergite (Pl. VI, figs. 1—4) bears in *Loemopsylla* and allies on each side 14 setiferous grooves. There are fleas, however, in which the grooves are more numerous (for instance in *Chaetopsylla*). The dorsal outline of the plate is straight, and not much curved in lateral aspect. The ninth sternite is membranaceous laterally, extending far downwards, the most ventral portion being more strongly chitinized and forming a small sclerite. This plate lies inside the seventh or eighth segment and forms the ventral wall of the vaginal cavity, the duct of the *receptaculum seminis* ending above this plate (Pl. VII, fig. 4). The stylet of the anal (= tenth) segment is short and conical, being longer in *pallidus* than in the other species of *Loemopsylla*. The anal sternite is usually triangular in side-view (Pl. VI, figs. 1—4), bearing a long bristle ventrally before the apex and several shorter ones at the apex, there being also 3 or 4 bristles at the upper edge nearly equidistant from each other.

The sexually modified abdominal segments of the ♂♂ of the various members of the genus *Loemopsylla* (Pl. IV, figs. 6—12; Pl. V, figs. 1—6) exhibit a very uniform type of structure, differing in several details from those of all other genera, with the exception of *Pariodontis* and *Moeopsylla*. The eighth tergite is small as compared with the eighth sternite, as is the case in all the allied genera. Its lower inner angle is not prolonged into a long slender manubrium as in *Pulex irritans*, being triangular in side-view. It slopes ventrally upwards, the ventral line being longer than the distance from the apex of the sternite to the upper corner of the stigma-cavity of the eighth tergite. The eighth sternite bears several bristles ventrally on each side, some species having only 2 or 3 bristles (*e.g. L. mycerini, erilli, ramesis* etc.), while others have a large number (*e.g. L. scopulifer, nubicus* etc.). The organs of copulation

project from the cavity formed by this sclerite. The genitalia are very small in *Loemopsylla,* the outline of the various projecting parts being difficult to make out in unmounted specimens except in a few species. These accessory copulatory organs are portions of the ninth segment. The central dorsal area of this tergite bears the sensory plate as in the ♀, the sides of the tergite being modified into clasping organs. This lateral portion, of which the main part may conveniently be called "clasper," is in *Loemopsylla* not separated from the dorsal portion by a suture. The lower inner angle of the clasper is produced inwards into a slender manubrium, which does not present any very striking differences in the various species of *Loemopsylla*, except in length (Pl. IV, fig. 6, M). Above the manubrium the inner edge of the clasper usually bears a slight tubercle-like projection. On the outer side of the clasper there are in *Loemopsylla*, *Moeopsylla* and *Pariodontis* three processes (P^1, P^2, P^3), of which two are movable, being connected with the clasper by a joint, while the third is often reduced or absent. These processes are very characteristic of the three genera mentioned, and are of great value in the discrimination of the species. They correspond to the large flap and the pair of pincers found in *Pulex irritans* (see Jordan and Rothschild, 1906, p. 38). The American non-combed eyed *Pulicidae* have a large clasper with one movable process, the manubrium being also large (Pl. VI, fig. 7). The ninth sternite is always strongly modified in Siphonaptera. In its most general form it is boomerang-shaped in side-view, consisting of an internal vertical, and a ventral horizontal arm, the latter projecting outside the eighth sternite. The vertical arm extends upwards to the base of the manubrium of the clasper, lying on the outer side of the manubrium, there being a vertical arm on each side of the abdomen. The horizontal arm is in *Pulicidae* either separated in the mesial line as far as the junction with the vertical arm, or there is no such separation into two ventral sclerites. In *Loemopsylla* as in *Pulex, Moeopsylla* and *Pariodontis* the sternite is much reduced, the vertical arm sometimes not reaching the clasper. The ventral arm is divided into two slender processes, which are different in shape in the various species. This double process is moved by means of a long chitinous rod projecting far into the abdomen. The clasping organs appear to be always the same on both sides of the abdomen in Siphonaptera, apart from slight differences such as every two sclerites may present.

Between the clasper and the ninth sternite the penis projects, the chitinous parts of which are very complicated (Pl. IV, fig. 6, Pen.). The outline of the internal elongate plates—one on each side—varies more or

less according to species. The external portion of the organ also exhibits sometimes notable specific differences, for instance, the brush-like structure in *L. pallidus* being a very striking characteristic for that species (Pl. IV, fig. 9).

The differences found in the genitalia of both sexes of insects are of special importance to the systematist, since they enable him generally to recognise the species when other organs fail to exhibit sufficiently striking characteristics. In the study of Siphonaptera we lay great stress on the differences existing in these organs, conforming thereby to the general experience of entomologists in other groups of insects. The minute study of the genitalia of Siphonaptera is a great necessity, since these insects do not present so many and so varied external differences as is usually the case with the species of the orders of winged Arthropods.

As the senior author of the present essay has made special researches bearing on the question (1896, p. 426; 1905, p. 163), a short resumé of what is known of the constancy and variability of the external genitalia will perhaps be serviceable for those who are not acquainted with the taxonomic value of these organs. The discovery of the existence of differences in the genitalia of male insects is due to Léon Dufour (1844, p. 253). For a long time after entomologists held the opinion that the differences had been created or had developed for the purpose of preventing the species from intercrossing. These differences were considered constant within each species, and it was generally thought that specifically distinct insects exhibited in the genitalia some morphological distinction from their nearest allies. Inversely it was accepted as a fact that all forms of insects which had some characteristic in the genitalia were specifically distinct. These notions of the origin and significance of the genital differences in forms of insects were somewhat crude, the differences having since been reduced to their proper value. We know now (1) that the majority of species of insects show some morphological distinction in the genitalia from their congeners, there being no obvious difference of this kind in a small minority; (2) that the genitalia vary to a generally slight extent individually; (3) that the succeeding broods of an insect, though often very different in other organs, have the same genitalia, the only exception so far known being a butterfly (*Papilio xuthus*) in the spring and summer broods of which the genitalia exhibit some slight and not quite constant differences between; (4) lastly, that the geographical forms of a species are very often different in respect to their genitalia (cf. Jordan, 1905, p. 151).

Now, the study of Siphonaptera is still in its infancy. We know next to nothing of the geographical variation of these insects; the study of that question has to be postponed till a sufficiently large amount of material from many countries is at disposal from which the geographical distribution of the various forms of Siphonaptera can be ascertained. That there is geographical variation also in Siphonaptera is proved to us by several species. It is, however, decidedly best to treat all forms which are constantly different as being specifically distinct, until more of the variation of the Siphonaptera is known.

The legs of *Loemopsylla* agree on the whole with those of *Pulex*, *Pariodontis* and *Ctenocephalus*, differing essentially from the legs of the American non-combed eyed *Pulicidae* both in the internal rod of the mid- and hindcoxa dividing nearer the base of the coxa, and in the hindcoxa bearing a row of teeth on the inner surface. There is considerable variation in the details of the shape and in the amount of bristles of the legs within the genus *Loemopsylla*, a number of species being easily distinguished by the legs alone. The forking of the internal rod of the midcoxa near the base instead of in the centre of the coxa appears to us a character of considerable taxonomic value, being apparently a specialization obtaining only in some Old World genera.

As a rule the hind-edge of the mid- and hindcoxae of *Loemopsylla* is more or less excised before the apex, but there are also species in which this edge gradually slopes away. The coxae, for instance, in *cheopis*, *nubicus*, *pyramidis*, etc. have a distinct sinus, while in *isidis*, *creusae*, etc. the sinus is wanting and the hindcoxa of these species is pear-shaped (Pl. II, figs. 14—16). The sinus in *gerbilli*, *mycerini*, *erilli*, etc. is very shallow, the hind angle being completely rounded off. The number of spines in the comb of the hindcoxa is not the same in the various species of *Loemopsylla*, some species possessing only a few teeth, 4 or 5, while others have as many as 14 (*pyramidis*, for instance), but the number of teeth varies considerably within the species. The coxal comb is only found in some Old World genera of Siphonaptera and some Nearctic forms, but not in any Neotropic fleas. The femora present likewise some specific differences. The most notable distinction is that found in the hindfemur (Pl. II, figs. 6 and 7). This femur is flattened or grooved longitudinally on the ventral side, the edges of the flattened area converging anteriorly, and meeting at the point, where the ventral surface of the femur bears a distinct tooth-like projection. This obtains in six species (*pyramidis*, *cheopis*, *nubicus*, *cleopatrae*, *pallidus* and *eridos*). In the other species the femur is simply rounded, the tooth being also less

prominent in *cheopis* than in the other forms mentioned (Pl. I). The hindfemur in *Loemopsylla* always bears a row of hairs on the inner side. The tibiae are never hairy all over the outer surface. The relative length of the bristles of the tibiae and of the tarsal bristles, especially of those placed at the apex of the second hindtarsal segment, afford reliable distinctions, at all events between some of the species (Pl. III, figs. 7 and 8). The fifth tarsal segment bears 4 bristles on each side, besides a thin hair situated between the third and fourth bristles and placed a little more dorsad than these. Ventrally at the apex there are either 1, 2 or 3 short spine-like bristles, the number being sometimes not quite constant in the various individuals of a species (Pl. III, figs. 7, 8). The fore-, mid- and hindtarsi also differ as a rule in this respect.

24 species of *Loemopsylla* are known. The number will doubtless be greatly increased when the Siphonaptera of Asia and tropical Africa are better known. We are not acquainted with two of the species, described by Enderlein and Wagner respectively. They are placed in the present article where we think they belong according to the descriptions given by the authors, which are quite insufficient.

Key to the species of Loemopsylla.

a. Frontal portion of head with 1 or 2 long bristles .....b
Frontal portion of head with 6 long bristles .....Species No. 24

b. Episternum and sternum of metathorax not separated from each other by a suture ; hindfemur with or without tooth ventrally at the widest point c
Episternum and sternum of metathorax separated from each other by a suture ; hindfemur with tooth ventrally at the widest point.....g
Episternum and sternum of metathorax separated from each other by a suture ; hindfemur without a tooth ventrally at the widest point .....o

c. Hindfemur with a tooth ventrally at the widest point .....d
Hindfemur without this tooth .....Species No. 5

d. Fourth segment of hindtarsus short, triangular in outline .....e
Fourth segment of hindtarsus elongate .....f

e. Middle tergites of abdomen with a row of 8 or more bristles on the two sides together .....Species No. 1
Middle tergites of abdomen with a row of 6 or less bristles on the two sides together .....Species No. 2

f. Rostrum reaching to the trochanter .....Species No. 3
Rostrum not reaching to the trochanter .....Species No. 4

g. Subapical bristle of the seventh abdominal tergite in ♂ on a conical process which projects beyond the apex of the segment ; seventh sternite of ♀ with about 15 bristles in front of the postmedian row on the two sides together ...Species No. 13
Subapical bristle of ♂ on a process, hindfemur in both sexes with 3 bristles on the outer side .....Species No. 14

Subapical bristle of ♂ not on a process ; seventh sternite of ♀ with many less than 15 bristles ; hindfemur with 2 bristles on the outer side .....h

h. Subapical bristle of seventh abdominal tergite at least as long as the second hindtarsal segment.....i

This bristle considerably shorter than the second hindtarsal segment .....n

i. Epimerum of metathorax with 4 bristles.....Species No. 7

Epimerum of metathorax with at least 10 bristles .....k

k. Longest apical bristle of second hindtarsal segment hardly reaching the base of the fifth segment .....Species No. 10

This bristle reaching to the middle of fifth segment or beyond l

l. First midtarsal segment hardly two-thirds the length of the second. Species No. 9

First midtarsal segment three-fourths the length of the second .....m

m. Both processes of the clasper slender.....Species No. 8

One of the two processes broad, its upper edge rounded..... .....Species No. 6

n. On the epimerum of the metathorax at least one bristle situated above the stigma .....Species No. 12

All the bristles of the epimerum of the metathorax ventral to the stigma. Species No. 11

o. Hindcoxa pear-shaped, the comb situated near the apex .....p

Hindcoxa more or less sinuate behind near the apex .....r

p. Rostrum shorter than the maxillary palpus .....Species No. 15

Rostrum longer than the maxillary palpus .....q

q. Apical margin of the seventh abdominal tergite strongly chitinized dorsally, projecting backwards .....Species No. 17

This portion of the segment hardly more chitinized than the rest of the segment, projecting very slightly backwards ....Species No. 16

r. Rostrum reaching beyond the trochanter .....Species No. 18

Rostrum at the most reaching to the apex of the forecoxa .....s

s. Rostrum shorter than the forecoxa .....t

Rostrum extending to the apex of the forecoxa .....Species No. 22

t. First hindtarsal segment with 5 apical bristles which extend to the apex of the second segment or beyond .....Species No. 20

First hindtarsal segment with less than 5 bristles which reach to the apex of the second segment .....u

u. Rostrum longer than the maxillary palpus .....Species No. 19

Rostrum as long as the maxillary palpus ; upper process of the clasper (♂) broad, truncate .....Species No. 21 (and 23 ?)

1. Group of species.

Episternum and sternum of metathorax fused, the sternum either bearing a short hair or none (see diagram, p. 25). The fifth segment of all the tarsi has in both sexes two ventral apical bristles, one being long, the other short. Hindfemur angulate (with the exception of *L. longispinus*), bearing one subapical bristle on the outside. Manubrium of clasper short ; penis with a kind of brush at apex. To this group belong Species No. 1—5.

(1) **Loemopsylla pallidus** *Taschenb.* (1880).

(Pl. III, fig. 4; IV, fig. 9; V, fig. 8.)

Pulex pallidus, Taschenberg (1880 *a*, p. 65, n. 5, t. 1, fig. 9, Egypt, off *Herpestes ichneumon*); Baker (1895, p. 66, Socotra); Rothschild (1903, p. 542=*witherbyi*); Wagner (1903, p. 308); Tiraboschi (1904, p. 249); Baker (1905 *a*, p. 143, bibliography).

Pulex witherbii, Witherby (1902, p. 60, indescript).

Pulex witherbyi, Rothschild (1903, p. 86, n. 6, t. 1, figs. 2, 5, 6, t. 2, figs. 11, 15, White Nile and Shendi, off *Erinaceus albiventris*, etc.).

The insect recorded by Baker (1895, p. 66) from Socotra may possibly not be this species.

Head. The rostrum reaches beyond the apex of the forecoxa. The first segment of the maxillary palpus is a little longer than the third, and the second longer than the fourth. The most ventral bristle of the subapical row of the occiput is placed far apart from the next one, the second, or the second and the third, bristle being absent or replaced by a small hair. The first segment of the antenna of the ♂ bears 6 hairs along the hinder edge and an oblique row of about 7 across the segment ending at the anterior apical corner. In the ♀ the apical projection of the first antennal segment bears 2 hairs.

Thorax. The tergites bear 9 to 11 bristles on the two sides together. The pleura of the prosternite is pointed behind. The mesosternite bears 3 bristles. The internal rod of this plate, extending from the insertion of the coxa upwards, ends dorsally at the anterior corner of the sclerite, the portion of the plate situated in front of the rod being very narrow (side-view, see diagram, p. 25). The episternum of the metathorax is completely fused with the sternum, and of nearly the same size (lateral view), the line of separation being indicated posteriorly at the meral suture (which separates the epimerum from the sternum and episternum). There is one long bristle on the episternum, while the sternum bears only a small hair or no hair at all. The epimerum has two rows of bristles, the numbers being in ♂ 3 and 4, and in ♀ 4 or 5, and 4.

Abdomen. The first tergite bears an antemedian and a postmedian row of 4 (♂) or 5 (♀) bristles, there being also some minute hairs on the side between the two rows. The second to fourth tergites in ♀ usually bear 10 bristles on the two sides taken together, but sometimes only 8, in the ♂ the number being 9 or 10. On the fifth and sixth tergites there are 8 bristles in the ♀ and 8 or 9 in the ♂, while the seventh tergite has 6 bristles, two on each side being placed ventral to

the long subapical bristle. The most ventral bristle of the seventh tergite is far apart from the next. The sternites of segments 4 to 7 bear on both sides together usually 4 bristles, sometimes 5, the third segment having one or two more, while the basal sternite bears 1 to 3 ventral bristles.

Legs. The forecoxa has 16 to 18 bristles. The hindcoxa, which bears a comb of 8 to 12 spines, is rather strongly rounded behind, the sinus being very shallow. The forefemur has 4 to 6 bristles on the outer surface and 3 on the inner. The midfemur bears a row of 6 bristles on the inside, the hindfemur one of 7 to 15 (usually 8 in ♂ and 10 in ♀). All the femora have one subapical bristle on the outside. The tibiae have a single lateral row of bristles, the row containing 8 to 10 on the hindtibia. The hairs on the anterior surface (at and near the anterior edge in a lateral view) are very few in number. The longest apical bristle of the hindtibia reaches beyond the apex of the first tarsal segment. In the fore- and midtarsi (Pl. III, fig. 4) the first segment is shorter than the third; while the second midtarsal one is more than twice the length of the first. The bristles of the hindtarsi are long, the longest apical one of the first segment extending beyond the tip of the second, and that of the second segment reaching the apex of the fifth. The fifth segment is large in all tarsi, being much widened apically. The side-bristles of the segment are long, the interspace between the third and fourth bristles being wide, with a subdorsal hair in between them. The segment bears in all the tarsi two apical ventral bristles, both being slender, the one being short and the other long. The proportional lengths of the segments[1] are as follows:—

Segment		First	Second	Third	Fourth	Fifth
Foretarsus:	♂	8	12	9	5	22
		7	11	9	6	21
	♀	9	15	11	7	25
		7	10	8	5	20
Midtarsus:	♂	12	24	13	8	24
		11	24	13	8	23
	♀	16	32	16	9	26
		10	20	11	6	21
Hindtarsus:	♂	37	31	17	9	25
		34	30	16	9	25
	♀	47	39	19	11	26
		30	26	13	8	22

[1] We give the measurements of a large and of a small specimen.

Modified segments. ♂. The eighth sternite (Pl. IV, fig. 9) bears 5 to 7 short bristles, 2 of them being placed near the apical margin. The clasper bears three processes, the central one being the narrowest, and the ventral one the shortest. The manubrium (M) is short, being about as long as (or even shorter than) the distance from its base to the tip of the longest process. The ninth sternite is narrow, and bent at the top into a short hook. The internal plate (endopodite) of the penis is broad, the apex being rounded off, with the upper corner remaining almost rectangular. The external part of the penis has the brush-like organ more strongly developed than that of any other species of *Loemopsylla*. —♀. The apical edge of the eighth tergite (Pl. V, fig. 8) is nearly straight, bearing a row of bristles as shown in the figure, there being, besides, on the outer surface one long bristle on a level with the uppermost apical one and 2 or 3 on a level with the ventral apical bristles.

Length. ♂ 1·7—2 mm., ♀ 2·1—2·9 mm.

The junior author found this species rather commonly on various hosts in Egypt and the Egyptian Sudan. We have a long series from the following localities and hosts:

Egypt, off *Viverra ichneumon* (♂ and ♀, cotypes, received from the Berlin Museum).

Shendi, Egyptian Sudan, off *Erinaceus aethiopicus*, *Vulpes niloticus* and *Hyaena hyaena*.

Gebel Auli, White Nile, off *Erinaceus albiventris* (collected by H. F. Witherby).

Kerma, Dongola, off *Gerbillus pygargus* and *Vulpes vulpes aethiopicus*.

Cairo, off *Erinaceus auritus*.

Zaghig, Natron Valley, Lower Egypt, off *Erinaceus auritus* and *Canis zerda*.

Der Macarius, Natron Valley, Lower Egypt, off *Vulpes famelica*.

Karo Lola, Garre Livin country, South Somaliland, off *Erinaceus albiventris* (collected by Baron Carlo von Erlanger).

(2) **Loemopsylla somalicus** *spec. nov.*

(Pl. III, fig. 8.)

This insect is closely allied to *L. pallidus*, differing, however, in the much smaller number of bristles.

Head. The subapical row of bristles of the occiput is represented on each side by a long ventral bristle and a small dorsal one, besides

some minute hairs. The first segment of the antenna bears in the ♂ 3 hairs at the hinder edge and close to the apex a transverse row of 4 or 5, the apical projection in the ♀ bearing one hair. There is a long bristle above the centre of the antennal groove.

Thorax. The epimerum of the metathorax bears very few bristles, the anterior row being represented by one bristle in the ♂, placed far downwards, and 2 in the ♀, while the posterior row contains 3 or 4 bristles. Each thoracic tergite bears 8 bristles on the two sides together.

Abdomen. The first tergite bears on the two sides together 4 postmedian bristles and before the centre a few minute hairs. There is no bristle beneath the stigma of the second to seventh tergites. The tergites 2 to 6 bear in the ♂ 4 bristles on the two sides together, the bristles being all dorsal, the more ventral ones usually situated in this position being replaced by minute hairs; in the ♀ the number of bristles on these segments is 6. On the seventh tergite there are 4 bristles in both sexes, one placed beneath the long subapical bristle.

Legs. The forecoxa has less than 15 bristles. The tibiae bear on the outer surface only one bristle, which is situated near the postmedian dorsal pair. The first and fourth midtarsal segments (Pl. III, fig. 8) are shorter than in *L. pallidus*. The fifth tarsal segment has no minute hairs on the ventral surface.

Modified segments. ♂. The first and third processes of the clasper are rather slenderer than in *L. pallidus*, the long subapical bristle being placed further away from the end. The ninth sternite is not so sharply hooked as in *L. pallidus*.—♀. The eighth sternite apparently as in *L. pallidus*.

We have both sexes from Karo Lola, Garre Livin country, South Somaliland, off *Sciurus spec.*, collected by the late Baron Carlo von Erlanger, on 5th May 1901.

(3) **Loemopsylla cleopatrae** *Rothsch.* (1903).

(Pl. III, fig. 7; IV, fig. 7.)

Pulex cleopatrae, Rothschild (1903, p. 84, n. 3, t. 1, figs. 4, 8, t. 2, figs. 13, 17, Shendi, off various hosts); Baker (1905, p. 141); Balfour (1906, p. 104, fig. 58).

A small pale species, which is easily recognised by the long fourth hindtarsal segment.

Head. The rostrum reaches to the trochanter. The proportional lengths of the segments of the maxillary palpus are 9, 12, 8, 14. The

occiput bears a subapical row of 12 to 14 bristles on both sides together. The first segment of the antenna has in the ♂ a curved transverse row of about 9 hairs, the apical projection of this segment bearing in the ♀ one hair.

Thorax. The pronotum has 16 to 19 bristles on the two sides together, the mesonotum 16 or 17, and the metanotum 18 to 20. The mesosternite bears 3 to 5 bristles. There are 2 bristles and one or two minute hairs on the episternum of the metathorax; the sternum bearing a small hair. On the epimerum of the metathorax there are two rows of bristles, the anterior row containing 6 to 9, the posterior row 5 or 6, the most dorsal bristle of each row being placed above the stigma in both sexes.

Abdomen. The two rows of bristles on the first tergite contain each 8 to 10 bristles on the two sides together, the number of bristles on the other tergites being as follows:—ii. 19 to 21; iii. 19; iv. 20 or 21; v. 19; vi. ♂ 14 to 18, ♀ 20; vii. ♂ 14, ♀ 16. On the sternites of segments 3 to 7 there are in the ♂ 4 or 5 bristles, in the ♀ 6 to 8 (usually 8).

Legs. The forecoxa bears 22 to 26 bristles. The hindcoxa is broadly rounded, the sinus being rather deep and the angle behind it distinct. The femora have one subapical bristle on the outside, the midfemur bearing on the inside 2 bristles and the hindfemur 5. The first midtarsal segment is much longer than the third. In the hindtarsus the second segment is very slender and the fourth about two and a half times as long as it is broad (Pl. III, fig. 7). The longest apical bristle of the second hindtarsal segment nearly reaches to the apex of the fifth. The fifth segment is only slightly widened towards the apex. The proportional lengths of the segments are as follows:—

Segment		First	Second	Third	Fourth	Fifth
Foretarsus:	♂	7	8	5½	4	14
	♀	9	10	6	5	15
Midtarsus:	♂	14	18	10	6	17
	♀	20	25	14	7	18
Hindtarsus:	♂	40	36	20	13	19
	♀	48	42	24	13	20

Modified segments. ♂. The eighth sternite has 5 or 6 bristles, of which three are situated along the ventral margin, the fourth is placed above the second ventral bristle, the fifth is much more dorsal, being situated at about two-thirds the distance from the ventral margin to the stigma, an occasional sixth bristle being situated between the fourth and

fifth. The clasper (Pl. IV, fig. 7) has two slender free processes, both bearing hairs at the apex, the upper one bearing also two longer bristles. A third, smaller, process, placed beneath the two free processes, is not separated from the body of the clasper. The manubrium is short and slender. The ninth sternite (ix. st.) is distinctly dilated at the apex, the ventral margin being there rounded. The internal plate of the penis is rounded at the apex.— ♀. The apical edge of the eighth tergite is rounded. At the apical edge and above the ventral edge there is a row of 8 to 10 bristles, the apical margin bearing in addition from 5 to 8 smaller bristles which are placed on the inner side of the segment. On the lateral surface there are, besides, 5 to 10 bristles, of which two, rarely one, are placed beneath the stigma, but some distance from it.

Length. ♂ 1—1·4 mm., ♀ 1·4—1·7 mm.

This species was also found commonly by the junior author on various hosts in Egypt and the Sudan, as detailed below:—

Shendi, Sudan, off *Gerbillus pygargus, Dipodillus watersi, Jaculus jaculus, Lepus aethiopicus* and *Erinaceus aethiopicus.*

Kerma, Dongola, off *Gerbillus pygargus.*

Shereik, N. Sudan, off *Gerbillus pygargus* and *Acomys witherbyi.*

Khartoum, off *Gerbillus gerbillus* (collected by Dr A. Balfour).

Albumar, Bir Victoria, Natron Valley, off *Ictonyx libyca.*

Zaghig, Natron Valley, off *Gerbillus tarabuli* and *Jaculus jaculus.*

Bir Victoria, Natron Valley, off *Lepus rothschildi* and *Gerbillus tarabuli.*

Mt Mulluk, Natron Valley, off *Meriones sellysii.*

(4) **Loemopsylla pyramidis** *Rothsch.* (1904).

Pulex pyramidis Rothschild (1904 *b*, p. 3, n. 3, Natron Valley, Lower Egypt, off *Jaculus jaculus*); Baker (1905, p. 143).

Only one ♀ is known to us. The specimen very closely resembles that sex of *L. cleopatrae* and is perhaps only an exceptionally large individual of that species. The rostrum, however, does not reach the trochanter; the episternum of the metathorax bears only one long bristle, besides some minute hairs; and the hindtibia has two additional lateral bristles between the lateral row and the dorsal edge. The ♂ might possibly be abundantly distinct from *L. cleopatrae.*

One ♀ off *Jaculus jaculus*, found by the junior author at Bir Victoria, Natron valley, Lower Egypt, on March 9th 1903.

(5) **Loemopsylla longispinus** *Wagn.* (1893).

(Pl. III, fig. 9.)

Pulex longispinus Wagner (1893, p. 355, t. 6, fig. 1, ♀, West Turkestan, off *Erinaceus spec.*); Baker (1904, p. 437).

This is the only species known in which the episternum and sternum of the metathorax are fused, while at the same time the hindfemur is non-angulate ventrally near the base.

Head. The rostrum does not quite reach the trochanter. The first segment of the maxillary palpus is longer than the third, while the second is longer than the fourth. There is a wide interspace between the first and second bristles of the subapical row on the occiput. The apical projection of the first antennal segment of the ♀ is broad, bearing one hair at the tip.

Thorax. The bristles on the three tergites, on the two sides together, are respectively 17, 20, and 17. The mesosternite bears 3 bristles. The episternum of the metathorax has one bristle, while the epimerum bears two rows of 5 each, the bristles of the posterior row being very long.

Abdomen. The anterior row of bristles on the first tergite consists of 4 and the posterior row of 8 bristles on the two sides together, the number of bristles on the following segments being 15, 14, 12, 12, 10 and 10. The basal sternite bears a ventral pair and about 5 more bristles on each side, the other sternites having a single row consisting of 11, 8, 6, 6 and 6 bristles respectively.

Legs. The comb of the hindcoxa contains 14 or 15 spines. The bristles on the upper side of the femora are exceptionally long. The mid- and hindfemora have one subapical bristle on the outer side, bearing a row of 8 and 9 respectively on the inner side. The bristles of the tibiae are very long and strong (Pl. III, fig. 9). The longest apical bristle of the hindtibia extends beyond the apex of the first tarsal segment. In the foretarsus the second segment is twice as long as the first, while the first segment of the midtarsus is more than twice the length of the first. There are 6 bristles at the apex of the first hindtarsal segment which reach to the apex of the second or beyond, while there are 4 apical bristles on the second segment which reach beyond the middle of the fifth. The fifth segment is dilated at the apex, the lateral bristles being long and stout.

Modified segments. ♀. The apical margin of the eighth tergite is nearly straight. There is a row of 9 bristles along the apical and

ventral margin, 2 more bristles being placed on the lateral surface. On the inside of the apical margin there are 16 bristles and hairs.

The above description is taken from a ♀ received from Dr J. N. Wagner, of Kieff. The ♂ is not yet known.

The insect has so far only been found on *Erinaceus auritus* in West Turkestan.

2. Group of species.

Episternum of metathorax separated from sternum (see diagram, p. 25), the latter bearing a bristle which is as long as that situated on the episternum. Hind-femur angulate ventrally at the widest point, fifth segment of fore- and midtarsi with three spine-like bristles ventrally at apex, the lateral ones being very stout in ♂. Clasper with two distinct free processes ; manubrium long ; penis without a kind of brush near apex. To this group belong Species No. 6—13.

(6) Loemopsylla cheopis *Rothsch.* (1903).

(Pl. I ; II, fig. 8 ; IV, fig. 8 ; VI, fig. 1.)

Pulex cheopis Rothschild (1903, p. 85, n. 4, t. 1, figs. 3, 9, t. 2, figs. 12, 19, Shendi, off *Acomys*, *Arvicanthis*, etc.); Wagner (1903, p. 308); Baker (1905 *a*, p. 141); Advisory Committee (1906, p. 421, history of plague investigation, literature); Rothschild (1906 *b*, p. 483); Advisory Committee (1906, p. 486, t. 9, mouth-parts and alimentary canal); Advisory Committee (1907, pp. 446, 472, t. 10—12, morphology); Tiraboschi (1907, pp. 570, 581).

Pulex brasiliensis Baker (1904, p. 379, Saõ-Paulo, off *Mus rattus* and *decumanus*); Baker (1905 *a*, p. 129).

Pulex murinus Tiraboschi (1904, p. 251, fig. 15, ♂, Italy, off rats); Tiraboschi (1907, p. 570, = *cheopis*).

Pulex philippinensis Herzog (1904, p. 77, figs. 26, 27, Manila, off rats); Tiraboschi (1907, p. 582, "not proved to be the same as *cheopis*").

Head. The rostrum reaches to the apex of the forecoxa. The proportional lengths of the segments of the maxillary palpus are 12, 15, 11, 20. The subapical row of bristles of the occiput contains 6 bristles on each side. The first antennal segment of ♂ bears 4 hairs at the hinder edge and a transverse row of about 7, there being proximally to this row 2 or 3 additional hairs. In the ♀ the apical projection of the first antennal segment has 2 or 3 hairs at the tip, and about 4 minute ones on the outer surface of the segment as well.

Thorax. The number of bristles in the row on the pronotum varies from 13 to 16, on the mesonotum from 12 to 14, and on the metanotum from 11 to 12, the bristles of the two sides being counted together. The mesosternite bears 5 bristles on the side, the episternum of the metathorax one, and the epimerum 10 to 17 in two rows (5 to 8, 5 to 7).

The ventral angle of the metasternum is acuminate (see diagram, p. 25).

Abdomen. The first row of bristles on the first tergite consists in the ♂ of 5 to 7 bristles, in the ♀ of 6 to 10, the usual number being 6 in both sexes. The second row contains in the ♂ 6, in the ♀ 6 to 10 (usually 6) bristles. The numbers of bristles on the other tergites are as follows:—ii. ♂ 13 to 15, ♀ 15 to 21; iii. ♂ 14 to 15, ♀ 15 to 23 (usually 15 to 17); iv. ♂ 14, ♀ 14 to 23 (usually 15 or 16); v. ♂ 13 or 14, ♀ 15 to 22 (usually 15 or 16); vi. ♂ 15 or 16, ♀ 13 to 20; vii. ♂ 12 or 13, ♀ 12 to 17 (usually 14 or 15). The dorsal subapical bristle of the seventh segment is much longer than the second hindtarsal segment. The bristles on the sternites are as follows:—ii. 2 in ♂ and ♀; iii. ♂ 6 or 7, ♀ 9 to 12 (usually 10); iv. ♂ 6 to 8, ♀ 8 to 13; v. ♂ 6, ♀ 8 to 12; vi. ♂ 6 to 8, ♀ 8 to 12; vii. ♂ 6, ♀ 10 to 16, on this segment there being also one or more small hairs in front of the row.

Legs. The forecoxa bears about 30 or 32 bristles. The apical sinus of the hindcoxa is rounded, the angle behind it being distinct. The comb of the hindcoxa consists of 5 to 9 spines. The forefemur has 4 to 8 hairs on the outer surface, besides one subapical bristle. On the hindfemur there is on the inside a row of 5 to 9 bristles and on the outside 2 subapical bristles. The hindtibia bears on the outer surface 7 or 8, rarely 9, bristles, and two or three additional bristles between this row and the dorsal edge. The longest apical bristle of the hindtibia reaches to the subapical notch of the first tarsal segment. The second midtarsal segment is twice as long as the third. In the hindtarsus the fourth segment is twice as long again as it is broad. The longest apical bristle of the second segment extends to the middle of the fifth. The fifth segment is only slightly dilated towards the apex, bearing in the fore- and midtarsi three apical bristles on the ventral surface, the two lateral ones being short and stout in the ♂. In the hindtarsus this segment bears in both sexes two ventral apical bristles, one being short and the other long. The second hindtarsal segment is proportionately longer in the ♂ than in the ♀. The proportionate lengths of the segments are as follows:

Segment		First	Second	Third	Fourth	Fifth
Foretarsus:	♂	9	10	8	6	17
	♀	11	12	9½	7	20
Midtarsus:	♂	16	23	13	7	20
	♀	23	26	13	9	21
Hindtarsus:	♂	47	32	18	11	22
	♀	53	36	19	12	24

Modified segments. ♂. The eighth sternite (Pl. IV, fig. 8) bears 4 or 5 long bristles along the ventral edge, the last two being the longest; besides these there are a number of bristles on the side as shown in the figure. The manubrium (M) of the clasper is longer than the distance from its base to the top of the longer process of the clasper. There are two free processes to the clasper, the upper one being somewhat broad and asymmetrical, its upper margin being rounded, and the lower margin somewhat incurved, the bristles situated at and near the apex and upper margin being long. This process is very distinct from that of every other species known to us. The ninth sternite (ix. st.) almost gradually widens from the base to the apex, the upper margin being nearly straight and the ventral margin bearing a number of small hairs from near the base to the apex. The internal plate of the penis is somewhat curved upwards at the end, the ventral margin being rounded and the upper corner pointed.— ♀. The eighth tergite (Pl. VI, fig. 1) bears externally along the apical edge a row of 12 to 16 (usually 13) bristles, and a row of 8 or 9, rarely 10, shorter ones inside, on the outer surface there being an irregular row of usually 8 to 10 bristles which are placed between the lateral and apical rows. The stylet is short, bearing, besides the long apical bristle, one or two short ones situated on the outer surface.

Length. ♂ 1·4—1·7 mm., ♀ 2·1—2·7 mm.

This species appears to occur in all warm climates, being distributed by rats. It is presumably the means of the transmission of the bubonic plague from rat to man. The true home of this flea appears to be the Nile Valley, where it occurs commonly on various hosts.

Though we have not seen the specimens which were named *brasiliensis* and *philippinensis* (see bibliography, above), we have little doubt that the names refer to the present insect.

L. cheopis formerly was generally referred to as *Pulex pallidus* Tasch. in the literature on bubonic plague.

In most of the ♀♀ off *Gerbillus* and *Jaculus* as well as in the single one we have off *Lepus rothschildi*, the hindcoxa is broader than is the case in typical *cheopis*. The first midtarsal segment, moreover, is longer and the tooth of the hindfemur larger. These specimens are possibly the ♀♀ of the two ♂♂ mentioned under *L. nubicus*.

We have *L. cheopis* from the following localities and hosts:

Shendi, Egyptian Sudan, off *Acomys witherbyi*, *Arvicanthis testicularis*, *Dipodillus watersi* and *Genetta dongolana*.

Meroe, Dongola, off *Arvicanthis testicularis*.

Pretoria, Transvaal, off *Mus decumanus.*
Beira, East Africa, off *Mus chrysophilus.*
Entebbe, Uganda, off man.
Benguella, Angola, off *Mus rattus* and *Funisciurus spec.*
Plaines des Palmes, Réunion, off *Crocidura murina.*
Marseille, France, off rats.
Plymouth, England, off a rat.
Adana, Asia Minor, off *Mus decumanus* and *Mus spec.*
Muscat, Arabia, off *Mus decumanus.*
Bombay, off deer.
Agra, India, off rats.
Jacobabad, India, off *Mus rattus rufescens.*
Loo Choo Is., Japan, off *Crocidura caerulea*[1].
Freemantle, West Australia, off *Mus decumanus.*
Paramatta, New South Wales, off *Mus decumanus.*
Onaca, Santa Marta, Colombia, off rats.
Sapucay, Paraguay, off *Mus rattus* and *alexandrinus.*
San Bernardino, Paraguay, in a cellar frequented by rats.

(7) **Loemopsylla aequisetosus** *Enderl.* (1901).

Pulex aequisetosus Enderlein (1901, p. 554, fig. B, t. 35, fig. 7, ♀ 10, Togoland, off *Cricetomys*); Wagner (1903, p. 309, "descript. insufficient"); Baker (1905 *a*, p. 140).

We have not had an opportunity of examining the specimen upon which the name is based. This specimen being unique, the authorities of the Berlin Museum were not allowed to lend it to us. The director of that institution, however, has kindly supplied us with information of the more important details respecting the structure of this insect, which are not mentioned in the original description nor shown in the figures accompanying the same.

According to this additional information the episternum of the metathorax is separated from the sternum, and the hindfemur bears a minute ventral tooth. This insect, therefore, belongs to the present group of species. In the original description the segments of the maxillary palpus are said to be almost the same in length, while we are now informed that the proportional lengths are 10, 13, 9, 14. The epimerum of the metathorax bears 4 bristles, according to our informant. The tergites of the thorax and abdomen bear each a row of

[1] These large shrews like rats inhabit ships and consequently transported from place to place.

about 10 to 12 bristles according to Enderlein, there being an additional row on the first abdominal tergite. The sternites of the third to seventh abdominal segments have each a row of about 6 to 8 bristles. The rostrum is longer than the maxillary palpus.

The insect is apparently closely allied to *L. cheopis*.

Mangu, Togoland, West Africa, August 1898, off a species of *Cricetomys spec.*; one ♀ in the Berlin Museum.

(8) **Loemopsylla nubicus** *Rothsch.* (1903).

(Pl. III, fig. 6; IV, fig. 6.)

Pulex nubicus Rothschild (1903, p. 84, n. 2, t. 2, figs. 10, 16, Shendi, off various hosts); Wagner (1903, p. 308); Baker (1905 *a*, p. 142).

Closely resembling *L. cheopis*. We are not sure that we have the ♀. The specimen which we originally described as the ♀ of *nubicus* now appears to us to belong to *cheopis*. There are no specimens among our material which with safety can be regarded as the ♀ ♀ of *L. nubicus*.

The ♂ is easily distinguished from *L. cheopis* by the genitalia. The clasper (Pl. IV, fig. 6) bears two slender processes, the shorter process having 3 to 5 bristles at the apex, of which the one occupying the tip is the longest. On the dorsal side there is another pair of hairs, placed at two-thirds or three-fourths the distance from the base. The horizontal portion of the ninth sternite (ix. st.) is transparent, being very slightly chitinized, except its ventral margin and base. Along the ventral margin there are from 10 to 13 hairs. The internal plate of the penis (Pen.-Pl.) is broad, its apex being rounded, with the upper corner slightly angulate.

Length. ♂ 1·4—2 mm.

Our series of ♂♂ collected by the junior author are as follows:

Shendi, Egyptian Sudan, February and March 1901, off *Arvicanthis testicularis*, *Herpestes albicauda*, *Genetta dongolana*, and *Gerbillus robustus*.

Nakheila, Atbara R., no host given.

Bir Victoria and Zaghig, Natron Valley, Lower Egypt, March 1903, off *Jaculus jaculus*.

We have also two ♂♂ off *Gerbillus gerbillus* and *Jaculus jaculus*, which are rather larger than the ones mentioned above; their hindcoxa is broader, the first midtarsal segment a little longer and the tooth of the hindfemur rather more strongly developed. The genitalia are

apparently not different from those of typical *nubicus*. The aberrant ♀♀ mentioned under *cheopis*, possibly belong to these ♂♂. The material is not extensive enough to enable us to decide whether these specimens are merely large individuals of *nubicus*, or whether they represent a distinct species. The relatively broad hindcoxa they share with *chersinus*. In the latter insect, however, the first midtarsal segment is much shorter.

(9) **Loemopsylla chersinus** *Rothsch.* (1906).

(Pl. III, fig. 5; V, fig. 5.)

Pulex chersinus Rothschild (1906 *a*, p. 75, t. 4, fig. 1—3, Khartoum, off *Jaculus gordoni*).

Closely allied to *L. nubicus* and *cheopis*. The subapical bristle of the seventh abdominal tergite is as long as the second hindtarsal segment. The hindcoxa is broader than in the allied species, bearing a comb of five spines. The first midtarsal segment is short, being only two-thirds the length of the second (Pl. III, fig. 5). The genitalia resemble those of *nubicus*; but the most proximal bristle of the broader process is situated much nearer the apex (Pl. V, fig. 5).

We have only one ♂ (the type) found on *Jaculus gordoni* at Khartoum by Dr A. Balfour.

(10) **Loemopsylla nesiotes** *spec. nov.*

(Pl. III, fig. 3; VI, fig. 4.)

Larger than *L. nubicus*; the bristles of the tibiae and tarsi much stouter and shorter.

Head. The rostrum reaches to the trochanter. The first segment of the maxillary palpus equals the third, the proportions of the four segments being 14 to 16, 18 to 19, 14 to 16, and 24.

The first antennal segment of the ♂ bears 4 minute hairs at the hind edge, a transverse row of 7 or 8, and proximally to this row 1 or 2 additional hairs. Above the antennal groove there are, in ♂, 15 or 16 small hairs.

Thorax. The pronotum bears, on the two sides together, 13 to 15 bristles, the mesonotum 13 or 14, and the metanotum 12 to 14. There are usually 5 bristles on the pleura of the mesosternite, but occasionally only 4. The episternum of the metathorax bears 12 to 14 bristles arranged in two rows (6 to 9, 5 to 6).

Abdomen. The first row on the first tergite contains 6 or 7 bristles, and the second row 6 on both sides together, the numbers of bristles on the other tergites being on the two sides together, 16 or 17, 16, 15 or 16, 14, and 13 or 14. On the sternites of segments 2 to 7 the numbers of the bristles are in the ♂ 2, 7 or 8, 7 to 9, 10 or 11, 8 to 10, and 10, there being 2 to 4 small hairs in front of the row on the seventh segment. In the ♀ the numbers of bristles on the sternites 3 to 7 are rather larger than in the ♂. The dorsal subapical bristle of the seventh sternite is nearly as long as the first and second midtarsal segments together.

Legs. On the forecoxa there are close on 40 bristles. The forefemur bears on the outer side 6 to 8 hairs. On the midfemur there are laterally 4 or 5 subventral bristles on the inside and 2 subapical ones on the outside, while the hindfemur has 5 to 7 on the inside and 2 on the outside. The bristles of the tibiae and tarsi are stout, being shorter and much stronger than in *L. nubicus* and also much shorter than in *L. cheopis* and *eridos*. The longest apical bristle of the hindtibia does not reach the subapical bristles of the first hindtarsal segment (Pl. III, fig. 3). The longest apical bristle of the first hindtarsal segment does not extend to the apex of the second segment, while the longest dorsal apical bristle of the second segment only reaches to the base of the fourth segment, the longest bristle on the anterior side of the second segment not even extending to the apex of the third segment, these bristles, therefore, being much shorter than in the allied species. The fifth segment bears 3 ventral apical spines in the fore- and midtarsi, and a long and short one instead in the hindtarsus, these bristles being stouter in the ♂ than in the ♀.

Modified segments. ♂. The genitalia are nearly as in *L. nubicus*. The bristles on the eighth sternite are more numerous, and there are also more hairs at and near the apex of the shorter one of the two processes of the clasper.—♀. The bristles of the eighth abdominal tergite are more numerous than in the allied species, especially the short ones situated on the inner side of the segment (Pl. VI, fig. 4).

Length. ♂ 2·3 mm., ♀ 2·6 mm.

We have 9 ♂♂ and 12 ♀♀ from Christmas Island, south of Java, taken off *Mus macleari* by C. W. Andrews, in December 1901.

The species is doubtless more widely distributed.

CORRECTION

p. 48, second line from the bottom,

instead of "C. W. Andrews" *read* "Dr H. E. Durham."

(11) Loemopsylla eridos *Rothsch.* (1904).

(Pl. VII, fig. 4.)

Pulex eridos Rothschild (1904, p. 611, n. 6, t. 8, fig. 21, t. 9, fig. 23, Deelfontein, off *Otomys brantsi*); Baker (1905 *a*, p. 141).

Head. The rostrum does not quite reach the trochanter. The first segment of the maxillary palpus is longer than the third, the second being a little shorter than the fourth. The subapical row of bristles of the occiput bears 5 or 6 bristles on each side. The first antennal segment of the ♂ is less produced posteriorly at the apex than in *L. cheopis* and *nubicus*; it bears 3 hairs at the hinder edge, and a transverse row of 5, proximally to which there are 2 more hairs. In the ♀ the projection of the first antennal segment bears one hair.

Thorax. The nota of the thorax bear usually 12 bristles on both sides together, the pronotum having sometimes 14 and the metanotum occasionally 11. The sternite of the mesothorax bears 3 hairs. The episternum of the metathorax has one bristle, while the epimerum bears an anterior row of 4 to 6 and a posterior row of 6.

Abdomen. The irregular anterior row of the first tergite on both sides together contains 7 to 10 bristles and the posterior row 6. The second to fifth tergites bear in the ♀ 16 to 18 bristles on both sides taken together, the sixth 15 or 16, and the seventh 12, the ♂ having 1 to 3 bristles less on the second to fifth tergites. The numbers of bristles on the sternites are as follows:—ii. ♂ 2, ♀ 2; iii. ♂ 4, ♀ 8; iv. ♂ 5 or 6, ♀ 8; iv. to vi. ♂ 5 or 6, ♀ 8; vii. ♂ 7, ♀ 6 to 8, the seventh segment bearing in ♀ some additional short bristles in front of the row. The dorsal subapical bristle of the seventh tergite is one-third shorter than the second hindtarsal segment, being very much shorter than in *L. cheopis* and *nubicus*, but agreeing with that of *L. niloticus*.

Legs. The forecoxa bears about 24 bristles. The hindcoxa is rather strongly sinuate posteriorly before the apex, the angle behind the sinus being distinct. The hindcoxa, on the inside, bears a comb of 6 to 9 spines, there being on the outer surface and along the anterior edge 22 to 24 bristles. The hindfemur bears a row of 5 to 7 bristles on the inside and 2 subapical bristles on the outside; the sub-basal ventral tooth of the femur is very distinct. The longest apical bristle of the hindtibia does not reach to the apex of the first hindtarsal segment. The first midtarsal segment is longer than the third, being two-thirds the length of the second. The longest apical bristle of the

first hindtarsal segment does not extend to the apex of the second segment, while that of the second segment reaches beyond the middle of the fifth. The fourth hindtarsal segment is about half as broad again as it is long. The fifth segment is small, being very slightly dilated towards the apex. In the hindtarsus this segment is shorter than the second. There are in both sexes on the ventral side of the fifth segment 3 apical bristles on the fore- and midtarsi and 2 in the hindtarsi, these bristles being thinner than in *L. cheopis*.

Modified segments. ♂. The eighth sternite bears about 10 bristles on each side. The clasper has two processes; the shorter one is cylindrical, bearing long bristles from near the base to the apex. The ninth sternite is obtuse at the tip, bearing here a number of fine hairs, there being also several at the ventral margin. The internal plate of the penis is curved upwards at the apex, which is pointed.— ♀. The apical margin of the eighth tergite is rounded; the segment bears on the outside an apical row of about 10 bristles, besides about 10 lateral ones. The ninth sternite, which lies inside the seventh, is different from that of all other species of *Loemopsylla*. Above the ventral edge of this sternite (Pl. VII, fig. 4, ix. st.) there is a bracket-like rod, which is the chitinized apical portion of the duct of the receptaculum seminis. At the tip of this rod there are two short, but strongly chitinized sclerites, which most likely serve as a clasping organ during copulation.

We have a series of specimens collected by C. H. B. Grant, as follows: Deelfontein, Cape Colony, March 1902, off *Otomys brantsi*; Umfolozi, Zululand, July 1904, off *Mus spec.*

(12) **Loemopsylla niloticus** *spec. nov.*

(Pl. V, fig. 3.)

Closely allied to both *L. nubicus* and *eridos*, but nearest to the latter, differing especially in the bristles of the episternum and epimerum of the metathorax and the first abdominal sternite.

Head. The apical corner of the first antennal segment of the ♂ is less produced than in *L. nubicus* and *cheopis*, the hairs on this segment, however, are placed nearly as in *cheopis*.

Thorax. The pronotum bears 17 to 19 bristles on the two sides together, the mesonotum 14 to 16, and the metanotum 16, the numbers varying to a certain extent, as in other species. There are 5 bristles on the side of the mesosternite. The episternum of the metathorax

bears 2 bristles, there being only one in the allied species. On the epimerum of the metathorax there are two rows of bristles, the first containing from 7 to 10 and the second from 6 to 8: the first bristle of the anterior row, or of both rows, being dorsal to the stigma, which is not the case in the other species of the present group of *Loemopsylla*.

Abdomen. The numbers of bristles on the tergites are as follows (on both sides together):—i. (two rows) 9 to 11 and 9; ii. 22 to 28; iii. 23 to 28; iv. 23 to 28; v. 22 to 26; vi. 20 to 27; vii. 17 to 22, the ♂ usually having a few bristles less than the ♀. The basal sternite bears in both sexes two ventral pairs of bristles, the one pair standing in front of the other; in the ♀ there are, moreover, 2 lateral bristles on each side, these bristles being replaced in the ♂ by minute hairs. None of the allied species have more than one ventral pair of bristles. On the following sternites the bristles are as follows:—iii. ♂ 10, ♀ 14 or 15; iv. ♂ 10, ♀ 14; v. ♂ 10, ♀ 16; vi. ♂ 10, ♀ 15 or 16; vii. ♂ 10, ♀ 15 or 16, there being in front of the row of the seventh segment a few minute hairs in ♂ and 7 to 12 bristles in the ♀ on both sides together. The dorsal subapical bristle of the seventh tergite is shorter than the second hindtarsal segment.

Legs. The hindfemur bears a row of 5 or 6 bristles on the inside, and has 2 subapical bristles on the outside.

Modified segments. ♂. The bristles on the eighth sternite are rather more numerous than in *L. cheopis*. The clasper bears two slender processes (Pl. V, fig. 3). The upper (= outer) process has 3 or 4 bristles at the tip and 3 more between the apex and the centre along the upper margin. The ninth sternite resembles that of *L. cheopis*, bearing a number of hairs at the apex and a very few additional ones further proximad and near the ventral margin. The internal plate of the penis (Pen.-Pl.) is slender, its apex being curved upwards and acuminate.—♀. The bristles on the eighth tergite are very numerous, the long bristles situated on the lateral surface being accompanied in the present species by an unusually large number of shorter bristles.

The junior author found a number of specimens of both sexes in Egypt and the Sudan on various hosts, as detailed below:

Nakheila, Atbara R., February 1904, off *Gerbillus robustus*.

Shereik, N. Sudan, January 1904, off *Gerbillus pygargus*.

Shendi, Sudan, March 1901, off *Arvicanthis testicularis* and *Gerbillus tatera*.

Kerma, Dongola, February 1904, off *Gerbillus pygargus*.

(13) **Loemopsylla scopulifer** *Rothsch.* (1905).

(Pl. V, figs. 1 and 9.)

Pulex scopulifer Rothschild (1905, p. 480, n. 2, t. 13, fig. 5, Umfolozi, South Africa, off *Saccostomus campestris*).

The ♂ differs abundantly from all the other species of *Loemopsylla* in the structure of the genitalia, as well as in the long subapical bristle of the seventh abdominal tergite being placed on a conical process, while the ♀ is distinguished by the stout bristles of the legs and the large number of bristles situated on the seventh abdominal sternite.

Head. The subapical row of the occiput contains 6 or 7 bristles on each side. There are 2 hairs at the tip of the conical projection of the first antennal segment of the ♀.

Thorax. The pro-, meso-, and metanota on the two sides together bear in the ♀ 16 bristles, while there are one or two less in the ♂. There are 5 or 6 bristles on the pleura of the mesothorax. The episternum of the metathorax has one bristle, and the epimerum in the ♂ usually 14 (7, 7) and in the ♀ 14 to 16 (9, 7 or 8, 6).

Abdomen. The number of bristles on the tergites are as follows (on the two sides together):—i. 14 to 16 in two rows (=7, 7 or 8, 8); ii. 18 or 19; iii. 18 to 21; iv. 16 to 20; v. 17; vi. 16; vii. 13 to 15. The dorsal subapical bristle of the seventh tergite which in the ♂ stands on a prominent conical process (Pl. V, fig. 1) equals in length the first and second midtarsal segments. On the sternites there are the following bristles:—ii. 2; iii. ♂ 9, ♀ 12; iv. ♂ 10, ♀ 12; v. ♂ 10, ♀ 10; vi. ♂ 10, ♀ 10 to 15; vii. ♂ 14, ♀ 18. On the seventh segment there are, moreover, in the ♂ about 3 hairs in front of this row, and in the ♀ about 15 or even more, on the two sides together.

Legs. The forecoxa bears about 37 bristles. The midfemur has 3 bristles on the inside and the hindfemur 4 or 5, while both have 2 subapical bristles on the outside. The bristles of the tibiae are stout. The shortest dorsal apical bristle of the foretibia is very blunt and thick, the other apical bristles being also less pointed than usual. The longer curved apical bristle of the hindfemur is shorter than the hindtibia is broad at the apex. In the ♂ the longest apical bristle of the hindtibia extends to the subapical notch of the first tarsal segment, while it reaches in the ♀ to the centre of the segment. The longest apical bristle of the second hindtarsal segment extends to the apex of

the fourth or base of the fifth segment, the longest bristle of the anterior side reaching only to the apex of the third segment. The fifth segment in the fore- and midtarsi of the ♂ has 3 ventral apical spine-like bristles, the central one being the longest, the lateral ones being short and very stout. In the ♀ this segment has, in contradistinction to the ♂, one long and one short bristle.

Modified segments. ♂. The eighth sternite bears about 22 bristles on each side. The clasper (Pl. V, fig. 1) has a short and a long process, the short one bearing some very stout bristles. The ninth sternite is stouter than is usual in this genus, the apex being hairy. The internal plate of the penis is pointed, the external plate becoming more and more acuminate towards the apex.—♀. The eighth tergite (Pl. V, fig. 9) has an external apical row of 10 to 12 bristles and an internal apical row of 10 short ones; there is, on the external surface also, a row of 8 to 10 bristles extending from the stigma downwards, 2 long bristles standing in between the lateral and apical rows.

Length. ♂ 1·5—2 mm., ♀ 1·7—2 mm.

A South African species, of which we have a series of both sexes as follows: Umfolozi Station, Zululand, taken in July and September 1904, off *Saccostomus campestris*, and also off *Mus auricomis*, September 1904; Beira, Portuguese East Africa, February 1907, off *Cricetomys gambianus*; all collected by C. H. B. Grant.

(14) **Loemopsylla tortus** *spec. nov.*

(Pl. V, fig. 4.)

Very closely allied to the preceding species. Both sexes, however, are larger. The hindfemur bears 3 subventral bristles on the outer side before the apex. The bristles situated at the apex of the hindtibia are longer than in *L. scopulifer*, the longest bristle reaching in the ♂ to the apex of the first hindtarsal segment and in the ♀ to the subapical notch of the same. The seventh abdominal sternite of the ♀ bears only 6 to 8 bristles in front of the postmedian row of bristles. The larger process of the clasper of the ♂ (Pl. V, fig. 4) has 6 bristles as in *L. scopulifer*, but these bristles are shorter and much thinner than in that species. The second process of the clasper is narrowed towards the apex and gradually curved upwards. The largest bristle of the anal tergite of the ♂ is longer than in *scopulifer*, as are also the bristles situated on the eighth sternite.

We have a small series of both sexes from Cajuno, Inhambane district, S.E. Africa, off *Mus spec.*, August 1906, and from Beira, S.E. Africa, off *Cricetomys gambianus*, February 1907, collected by C. H. B. Grant.

In the tube containing the specimens taken off *Cricetomys gambianus* there are both this species and *L. scopulifer*. The two insects, therefore, appear to exist side by side and must be regarded as distinct species.

3. Group of species.

Episternum of metathorax separated from the sterum. Hindfemur not angulate (Pl. II, fig. 6). Hindcoxa pear-shaped, the hind edge gradually sloping (Pl. II, fig. 15), the comb on the inside situated near the apex. Apex of pleura of prosternite obtuse. Metasternum rotundate in front. First abdominal tergite with one row of bristles. The bristle of the metathoracic sternum situated close to the meral suture. The bristles placed posteriorly near the apex of the hindcoxa short and stout. To this group belong species No. 15—17.

(15) Loemopsylla creusae *Rothsch.* (1904).

(Pl. II, fig. 11 ; IV, fig. 12.)

Pulex creusae Rothschild (1904 *a*, p. 608, n. 4, t. 8, fig. 18, t. 9, fig. 25, Deelfontein, off *Felis caracal*); Baker (1905 *a*, p. 141).

A deeply coloured species with short rostrum.

Head. The rostrum (Pl. II, fig. 11) of the ♂ is considerably shorter than the maxillary palpus, while in the ♀ it equals the palpus in length. The proportional lengths of the segments of the maxillary palpus are 9, 16, 10, 20 in the ♂, and 10, 22, 11, 19 in the ♀. The grooves of insertion for the small hairs which are dispersed over the dorsal and lateral surfaces of the head appear as very conspicuous pale dots in the dark chitin. The occiput bears 3 subapical bristles on each side, besides the one which is placed dorsally close to the mesial line, and which is very small in the ♀, the first and second subapical bristles being separated by a wide interspace. There is no long bristle above the antennal groove between the centre and the ventral subapical bristle, the postmedian bristle as well as the one which, in other species, is situated behind the base of the antennal groove, being replaced by minute hairs. The first antennal segment of the ♂ bears 3 hairs at the hind edge and a transverse row of about 6 near the apex ; in the ♀ there are 2 hairs at the tip of the apical projection.

Thorax. The pronotum bears a row of 10 to 12 bristles, the mesonotum a row of 8 or 9, and the metanotum one of 6 or 7 in the ♂ and 7 or 8 in the ♀, on the two sides together. The apex of the pleura of the prosternite is obtuse. The mesosternite bears 4 strong bristles, 2 of them standing close together above the stigma. The epimerum of the metathorax has a posterior row of 4 bristles in the ♂, and of 5 in the ♀, there being an additional bristle lower down on the sclerite representing the anterior row of other species of *Loemopsylla*. The apex of the metasternum is rounded.

Abdomen. The first tergite bears a row of 4 bristles on the two sides together. The second to seventh tergites have in the ♂ one bristle below the stigma and 4 (segment 6 and 7) or 6 (segment 2 to 5) on the back, there being a wide interspace between the infrastigmatical bristle and the dorsal ones. In the ♀ there are on the second to sixth segments 8 bristles, the gap between the two lower ones being much less wide than in the ♂, the second tergite bearing occasionally even 9 bristles. On the sternites the numbers of the bristles are in the ♂ 2, 4, 4, 4, 4 and 6; in the ♀ 2, 4 or 5, 5 or 6, 5 or 6, 6 and 7 to 9. The subapical bristle of the seventh tergite is short in both sexes.

Legs. The forecoxa bears 15 or 16 bristles. The comb on the pear-shaped hindcoxa is very variable, the number of spines being 3 to 10; the row is very irregular. There are 3 stout bristles posteriorly near the apex of the hindcoxa. The midfemur bears 2 subapical bristles on the outside and a row of 4 or 5 on the inside, the numbers being on the hindfemur 2 and 5 to 7 respectively. The tibiae have only one hair (or none) on the anterior surface, besides the apical and subapical bristles. The mid- and hindtibiae bear 6 pairs of dorsal bristles placed in notches (the apical bristles not being included in this number), the third pair being represented by a short stout bristle and a small hair. There is a regular lateral row of 7 or 8 bristles on the hindtibia. The longest ventral apical bristle of the hindtibia extends to the apex of the first tarsal segment, while the longest dorsal apical bristle reaches only to the subapical notch of the segment. The first and second hindtarsal segments are together as long as the hindtibia. The long bristles of the hindtarsus become very thin towards their apex, while the short apical bristles are stout and blunt. The long apical bristle of the second segment reaches beyond the base of the fifth. There is a long thin bristle at the apex of the fourth which extends to the claw. The fourth hindtarsal segment is nearly as broad as it is long. The fifth segment is large in all tarsi, distinctly widening apicad. The

lateral bristles of the same are long, those of the third pair standing close together. Ventrally at the apex this segment bears in all the tarsi one long and one short spine-like bristle.

Modified segments. ♂. The eighth sternite bears 4 or 5 small bristles on each side, besides one or two minute hairs. The clasper has two free processes, both being slender (Pl. IV, fig. 12). Beneath them there is a third short, broad process, which is not separated from the body of the clasper. The ninth sternite is somewhat acuminate, as shown in the figure, being elongate boat-shaped in side-view.—♀. The upper posterior corner of the eighth tergite is somewhat curved upwards, more distinctly so than in the ♂. The apical lateral margin is rounded. There is, on the outside, a row of about 15 bristles along the margin, besides 5 to 7 lateral bristles, 3 of the apical bristles being very stout; on the inside there are 5 or 6 apical bristles. The stylet is only a little longer than it is broad.

Length. ♂ 1·6 mm., ♀ 2·3 mm.

We have a large series of both sexes from Deelfontein, Cape Colony, off *Felis caracal*, March 1902, *Procavia capensis*, April 1902, and *Spreo bicolor*, May 1902, collected by C. H. B. Grant; also from Wakkerstroom, Transvaal, April 1904, off *Procavia capensis*, secured by the same collector.

(16) **Loemopsylla isidis** *Rothsch.* (1903).

(Pl. II, fig. 16 ; IV, fig. 11 ; VI, fig. 3.)

Pulex isidis Rothschild (1903, p. 313, n. 2, t. 5, figs. 2, 5, 6, 8, Harar, off *Procavia*); Wagner (1903, p. 508); Baker (1905 *a*, p. 142).

This insect, which agrees in size with *L. creusae*, is otherwise closely allied to *L. divergens*. It is much paler than both. The rostrum is longer than the maxillary palpus, reaching to the apex of the forecoxa. There is a bristle above the centre of the antennal groove on the occiput, this bristle being usually small in the ♀, while it is rather long and strong in the ♂. The subapical row of bristles of the occiput contains 5 bristles on each side, there being no wide gap between the first and second, as is the case in both *creusae* and *divergens*. The dorsal margin of the eighth abdominal tergite and the apical dorsal angle of the seventh are much less chitinized and project much less than in the two species mentioned. The number of bristles of the second to sixth tergites is 10 on the two sides together. The sternites bear about the same number of bristles as in *creusae*. The hindcoxa (Pl. II, fig. 16) has

only 2 bristles posteriorly at the apex. The upper process of the clasper is decidedly longer than in both the other species (Pl. IV, fig. 11). The eighth tergite of the ♀ (Pl. VI, fig. 3) bears along the margin about as many bristles as *creusae*, but these bristles are of more even size, the upper 3 or 4 not being much thicker than the following ones. The stylet of the ♀ is about twice as long as it is broad at the base.

A series of both sexes was received from Harar, taken off *Procavia erlangeri* on March 12, 1900 (Baron Carlo von Erlanger and Oscar Neumann).

(17) **Loemopsylla divergens** *spec. nov.*

(Pl. II, fig. 10; VI, fig. 2.)

Closely resembling *L. creusae*, with which it occurs together. The species is larger than *creusae*. The rostrum is much longer than the maxillary palpus and reaches to the apex of the forecoxa, the last segment (Pl. II, fig. 10) being half as long again as in *creusae*. The occiput bears a bristle above the centre of the antennal groove. The small hairs placed in the ♂ along the antennal groove are more numerous than in *creusae*. The second to sixth abdominal tergites bear 5 bristles on each side in the ♀, the interspace between the first and second bristle being smaller than the one between the second and third. In the ♂, however, the sixth tergite bears only 3 or 4 bristles on each side, the two lower ones being placed wide apart. The dorsal apical angle of the seventh and eighth tergites of the ♀ is more strongly curved upwards than in the ♀ of *creusae*. The sternites of segments 4 to 7, especially in the ♀, bear a few more bristles than in *creusae*. The genitalia of the ♂ are nearly the same as in *creusae*, but the two claw-like projections which protrude externally from the penis are larger and more strongly chitinized. The bristles along the edge of the eighth tergite of the ♀ (Pl. VI, fig. 2) are more numerous than in *creusae*. The stylet of the ♀ is almost thrice as long as it is broad at the base, being much longer than in *creusae*.

We have a series of both sexes, taken off *Procavia capensis*, April 1902, and off *Felis caracal*, March 1902, by C. H. B. Grant, at Deelfontein, Cape Colony. The present insect is perhaps a larger southern race of *L. isidis*.

4. Group of species.

Episternum of metathorax separated from the sternum. Hindfemur not angulate beneath near the base. Hindcoxa broader than in the three previous groups, posteriorly with two slender subapical bristles. Stigma of the proximal abdominal segments hardly larger than the groove for insertion of the first bristle of the tergites. Ventral angle of metasternum acuminate. To this group belong Species No. 17—21.

(18) **Loemopsylla erilli** *Rothsch.* (1904).

(Pl. II, figs. 6, 15; V, fig. 2; VII, fig. 5.)

Pulex erilli Rothschild (1904 *a*, p. 610, n. 5, t. 8, figs. 16 and 17, t. 9, fig. 22, Deelfontein, off *Zorilla striata*, *Suricata tetradactyla*, *Xerus capensis*).

Easily distinguished from the other species of *Loemopsylla* which have the hindfemur non-angulate by the long maxillary and labial palpi.

Head. The maxillary palpus reaches to the apex of the forecoxa, while the rostrum extends beyond the trochanter, being especially long in the ♀. The subapical row of bristles of the occiput contains 4 bristles on each side, the first and second being placed wide apart. There are about 30 small hairs above the antennal groove in the ♂. The first antennal segment of the ♂ is long.

Thorax. The bristles on the three tergites on the two sides together, are in the ♂ 12, 10, 8 or 9, and in the ♀ 12, 11 to 13, 10 or 11. The mesopleura bears 3 bristles. In the ♀ the epimerum of the metathorax has two rows of bristles (3, 4 or 5), the anterior row being represented in the ♂ by one bristle and the second by 3 to 5.

Abdomen. The first tergite bears two rows of bristles, the first row containing, on the two sides together, in the ♂ 2 or 3 bristles and the second row 4, the numbers being in the ♀ 3 or 4 and 5 respectively. On the second to seventh tergites there are on the two sides together the following numbers of bristles: ♂, 10 on tergites 2 to 6, and 6 or 7 on the seventh; ♀, 10 to 13, 11 or 12, 12, 10 or 11, 10 or 11, and on the seventh 7 or 8. The sternites bear in the ♂ 4 bristles, the first sternite having only 2, on the two sides together. In the ♀ the basal sternite bears 2 ventral bristles and on each lateral surface 4 or 5 more, the numbers on the next 5 sternites being 8 to 16, 6 to 9, 6, 6, and 4 respectively, on both sides together; the small number of bristles on the seventh sternite being a very remarkable character. The subapical bristle of the seventh tergite is shorter than the second midtarsal segment.

Legs. The forecoxa bears about 15 bristles. The hindcoxa is rather narrow, being in the ♂ half as long again as it is wide and bearing a comb of 7 to 9 spines. The sinus of the hindcoxa (Pl. II, fig. 15) is extremely shallow. Both the mid- and hindcoxae bear posteriorly 2 subapical bristles. The midfemur has exteriorly 1 or 2 subapical bristles and on the inner side a subventral row of 4, the numbers being on the hindfemur (Pl. II, fig. 6) 1 or 2 and 6 respectively. The hindtibia bears a lateral row of 4 to 6 bristles. The long apical bristles of this tibia are stout in the ♀, the ventral one extending to the apex of the first hindtarsal segment, while the dorsal one hardly reaches the subapical notch of this segment, both bristles being more slender and longer in the ♂. The longest apical bristle of the second hindtarsal segment in the ♂ reaches almost to the apex of the fifth segment, while in the ♀ it extends beyond the middle of the segment. The first hindtarsal segment has no bristles on the external surface, other than the bristles which are placed at the edges. The fifth hindtarsal segment is as long as the second midtarsal segment. In the fore- and midtarsi the fifth segment bears in the ♂ 4 short stout ventral apical bristles, 3 being placed at the apical edge and 1 proximally to them; no other species of the present group has 4 such bristles. In the hindtarsus of the ♂ and in all tarsi of the ♀ the fifth segment has 2 such bristles only, one being short and the other long.

Modified segments. ♂. There are 3 ventral bristles on each side of the eighth sternite, besides a very few minute hairs. The clasper (Pl. V, fig. 2) bears a long slender free process which has several long bristles at and near the apex, besides several smaller ones. A second process is conical, while a third is broad and short, being excavate on its upper surface. The ninth sternite (ix. st.) has a few minute hairs at the tip and one longer one proximally to the apex.—♀. The eighth tergite (Pl. VII, fig. 5) has an apical row of usually 6, sometimes 7 or 8, bristles and on the lateral surface 2 more bristles; on the inner side there is an apical row of 4 bristles and 1 or 2 minute hairs. The anal sternite is obliquely truncate. The stylet is more than twice as long as it is broad.

Length. ♂ 1·6 mm., ♀ 2·2 mm.

We have a series of this species from Deelfontein, Cape Colony, collected by C. H. B. Grant, as follows: *Zorilla striata*, August 1902; *Suricata tetradactyla*, April 1902; *Xerus capensis*, April 1902.

(19) **Loemopsylla mycerini** *Rothsch.* (1904).

(Pl. III, fig. 2; VII, fig. 2.)

Pulex mycerini Rothschild (1904 *b*, p. 1, n. 1, t. 1, figs. 1, 2, 4, Lower Egypt, off *Gerbillus tarabuli*); Baker (1905 *a*, p. 142).

Head. The rostrum is somewhat longer than the maxillary palpus, but does not reach to the apex of the forecoxa. The second segment of the maxillary palpus is shorter than the fifth, being one-fifth longer than the first. The subapical row of bristles of the occiput contains 4 bristles on each side, besides a dorsal one, the first and second bristles being placed wide apart. Beneath the first bristle there is a rather long thin hair. Above the centre of the antennal groove there is one long bristle.

Thorax. The pronotum bears 12 bristles, the mesonotum 12 in the ♂ and 10 or 11 in the ♀, the metanotum 8 or 9 in the ♂ and 10 in the ♀. The pleura of the mesothorax has 4 bristles, two of them placed close together above the stigma. On both the sternum and the episternum of the metathorax there is a single bristle, while the epimerum bears two rows of 6 to 8 bristles (2 to 4, 4). The pleura of the prosternite is pointed behind.

Abdomen. The first tergite bears two rows of bristles, the first row (which is sometimes missing in the ♀) containing 3 to 5, and the second 4 to 7 bristles. The second to fourth tergites in the ♂ bear 12 bristles on the two sides together and the fifth to seventh tergites 10 bristles; in the ♀ the second to sixth have 12 bristles and the seventh 10. The subapical bristle of the seventh tergite is much longer than the second midtarsal segment, equalling the second hindtarsal segment. The basal sternite bears in both sexes 2 ventral bristles on the two sides together, the following 4 sternites having in the ♂ 4 bristles and in the ♀ 6 to 8, the sternite of the seventh segment bearing 6 bristles in the ♂ and 8 in the ♀.

Legs. The forecoxa bears about 20 bristles. The hindcoxa is rounded posteriorly, the sinus being very shallow. There are 2 subapical bristles on the hinder side. The comb contains 6 or 7 spines. The hindfemur is broad near the base, being strongly rounded ventrally. It has a row of 5 to 7 bristles on the inside and 2, in the ♀ sometimes 3, subapical bristles on the outside. The longest ventral apical bristle of the hindtibia is a little shorter than the dorsal one, the latter reaching close to the apex of the first hindtarsal segment (Pl. III, fig. 2).

The second hindtarsal segment bears two long apical bristles on the posterior side, the longer one extending nearly to the apex of the fifth segment, while the other bristle only reaches to the centre of the segment. The fifth segment is only twice as long as it is broad near the apex, being but slightly dilated distally. There are in both sexes 2 ventral apical bristles on this segment.

Modified segments. ♂. These segments (Pl. VII, fig. 2) closely resemble those of *L. regis*. The eighth sternite bears 3 bristles on each side, one being lateral and two ventral, the second ventral bristle being placed close to the apex of the segment. The clasper has 3 processes. The first process is slightly widened distally and provided with an apical row of bristles; the second process is very slender, while the third is short and broad. The ninth sternite has a few minute hairs at and near the apex and two longer ones on the side.—♀. The eighth tergite has on the outside an apical row of 7 or 8 bristles, and 3 or 4 bristles on the lateral surface, while there is an apical row of 7 or 8 bristles on the inside. The stylet is about twice as long as it is broad near the base. The anal sternite is truncate, the apex being narrower (in side-view) than in *L. erilli*.

Length. ♂ 1·5 mm., ♀ 2 mm.

This species is known to us from Bir Victoria, Natron Valley, Lower Egypt, where the junior author took a series of it off *Gerbillus tarabuli* and *Pachyuromys duprasi natronensis*, in March 1903.

(20) **Loemopsylla gerbilli** *Wagn.* (1903).

(Pl. III, fig. 1; VII, fig. 1.)

Pulex pallidus Wagner (1894, p. 440, non Taschenberg 1880, err. ident.).
Pulex gerbilli Wagner (1903, p. 309, Transcaspia, off *Gerbillus*); Baker (1905*a*, p. 141).

Very close to *L. mycerini*. The insect differs from *mycerini* especially in the bristles of the tibiae and tarsi being considerably longer. The first hindtarsal segment, for instance, bears 5 apical bristles which reach to the apex of the second segment or beyond (Pl. III, fig. 1), and the second segment has 3 very long apical bristles, one extending beyond the apex of the fifth segment, another reaching to the apex and the third to the centre of the fifth segment. The tarsi, too, are much longer. The two free processes of the clasper (♂), moreover, are separated from each other (Pl. VII, fig. 1), and the third process is longer than in *mycerini*. The eighth sternite of the ♂ bears a ventral row of 4 bristles on each side.

We have only examined two specimens received from Dr J. Wagner, taken off *Gerbillus spec.* at Tedschen, Transcaspia, in July 1893.

(21) **Loemopsylla ramesis** *Rothsch.* (1904).

(Pl. V, fig. 6.)

Pulex ramesis Rothschild (1904 *b*, p. 2, n. 2, t. 1, fig. 3, Lower Egypt, off *Pachyuromys duprasi natronensis* and *Gerbillus tarabuli*); Baker (1905 *a*, p. 143).

Likewise closely related to *L. mycerini*. The rostrum, however, is only as long as the maxillary palpus, reaching to the apical third or fourth of the forecoxa, and the genitalia of the ♂ are very distinctive (Pl. V, fig. 6). The eighth abdominal sternite of the ♂ bears 2 long lateral bristles and a row of 2 to 4 ventral ones. The upper free process of the clasper is broad, truncate, bearing several long bristles at the apex and a number of shorter ones on the outer and upper sides. The third process is also broader and longer than in *mycerini*.

A small series of both sexes from Bir Victoria, Natron Valley, Lower Egypt, off *Pachyuromys duprasi natronensis* and *Gerbillus tarabuli*, March 1903, collected by N. C. Rothschild and F. R. Henley.

(22) **Loemopsylla regis** *Rothsch.* (1903).

(Pl. II, fig. 14; IV, fig. 10; V, fig. 7.)

Pulex regis Rothschild (1903, p. 312, n. 1, t. 5, figs. 1, 3, 4, 7, 9, S. Arabia, off *Meriones rex*); Wagner (1903, p. 508); Baker (1905 *a*, p. 143).

The numerous long and slender bristles situated on the thorax and abdomen distinguish this insect markedly from all the others of the present group of species.

Head. The rostrum in the ♂ is about as long as the maxillary palpus, reaching to the apex of the forecoxa, while in the ♀ it is longer than the palpus. The subapical row of bristles of the occiput contains on each side 6 to 8 bristles, there being also a long bristle above the centre of the antennal groove.

Thorax. The tergites bear, on the two sides together, a row of 18 or 19 bristles, there being some additional bristles on the back of the pro- and mesonotum in front of the row in the ♂. The pleura of the prosternite is pointed posteriorly. The mesopleura bears 5 or 6 bristles. There are 2 bristles on the episternum of the metathorax and 13 to 15 on the epimerum.

Abdomen. The first tergite has an irregular median row of 10 bristles and a postmedian row of 6 to 8 in the ♂, and 10 in the ♀, on both sides together, there being some additional bristles on the back. The numbers of bristles on the second to seventh tergites are in the ♂ 20, 20, 17 to 19, 17, 15 to 17, 14, and in the ♀ 22, 20 to 22, 20 to 22, 19 to 21, 19 or 20, 16 or 17. The subapical bristle of the seventh tergite is considerably longer than the second midtarsal segment. The bristles on the sternites are in the ♂ 2 on the basal one and 4 on the others, in the ♀ also 2 on the basal sternite and 6 to 8 on the others.

Legs. The forecoxa bears about 30 bristles. The hindcoxa (Pl. II, fig. 14) is much more rounded than in the allied species, bearing posteriorly 2 subapical bristles. The bristles of the tibiae and hindtarsi are long. The longest apical bristle of the second hindtarsal segment reaches far beyond the apex of the fifth segment, a second bristle on the same side extending to the apex of this segment, while a bristle on the anterior side of the second segment reaches at least to the centre of the fifth. This latter segment, in the ♂, is as long as the second midtarsal one, while in the ♀ it is shorter than that segment.

Modified segments. ♂. The eighth sternite bears one long bristle on the lateral surface and 2 to 4 along the ventral margin. The clasper (Pl. IV, fig. 10) has two free processes, one being long and rather broad, bearing a number of long bristles, the other being slender. The ninth sternite resembles that of *L. mycerini*.—♀. The eighth tergite (Pl. V, fig. 7) has an apical row of 7 to 9 bristles on the outside and of 7 or 8 on the inside, there being also from 3 to 5 lateral bristles on the outer surface. The anal sternite is acuminate.

Length. ♂ 1·3 mm., ♀ 1·8 mm.

We have specimens of both sexes from Lahaj, north of Aden, off *Meriones rex*, collected by Baron Carlo von Erlanger and O. Neumann on 21st December, 1899.

(23) **Loemopsylla conformis** *Wagn.* (1903).

Pulex pallidus Wagner (1894, p. 440, non Taschenberg, 1880, err. ident.).
Pulex conformis Wagner (1903, p. 508, n. 2, Transcaspia, off a small owl); Baker (1905 *a*, p. 141).

This insect is not known to us from specimens. It possibly may be the same as *L. ramesis*. The chief characters given by Dr Wagner are as follows:

The rostrum falls considerably short of reaching to the apex of the forecoxa. The lower angle of the eighth abdominal tergite of the ♀ is

not produced rectangularly. The eighth abdominal sternite of the ♂ bears 2 ventral bristles on each side, placed far apart from each other. The two movable processes of the clasper of the ♂ are larger than in *L. gerbilli.*

Dr J. Wagner received one pair of this insect from Sultan Bent, River Mourgab, Transcaspia, off a small species of owl.

5. Group of species.

Episternum of metathorax separated from the sternum. Hindfemur not angulate beneath, its greatest width further back than in all the other forms of *Loemopsylla.* Bristles of body and legs stout and black. Frontal portion of head with 6 long bristles; occiput with about 8 on each side, arranged in two oblique rows, besides the subapical row. Stigmata of abdomen longer than the groove for insertion of the first bristle of the tergite; in ♂ at least 2 bristles beneath the stigmata, in ♀ 4 or more. Midcoxa very strongly rounded behind, the hind edge being almost semicircular. To this group only species No. 24 belongs.

(24) **Loemopsylla chephrenis** *Rothsch.* (1903).

(Pl. II, figs. 5 and 7.)

Pulex chephrenis Rothschild (1903, p. 86, n. 5, t. 1, fig. 7, t. 2, figs. 14 and 18, Cairo, off *Acomys cahirinus* and *Dipus jaculus*); Baker (1905 *a*, p. 141).

Pulex alternans Wahlgren (1904, p. 1, figs. 1 and 2, Cairo, off *Acomys cahirinus*); Baker (1905 *a*, p. 140).

The most distinct looking species in the genus on account of the very dark coloured bristles.

Head. The frons (Pl. II, fig. 5) is more strongly and abruptly rounded, especially in the ♀, than in the other species of *Loemopsylla.* There are 6 long strong bristles on the frontal portion of the head. One of these bristles is placed in front of the eye, but at a distance from it, one above the insertion of the palpus, a third at the oral edge, a fourth beneath the eye and two more are situated on the genal process. On the occiput there is a subapical row of 7 strong bristles and two oblique lateral rows, the anterior one consisting of 3 bristles and the second one of 4. The ♂ has 5 to 8 small hairs above the antennal groove. The eye is small. The posterior apical angle of the first antennal segment of the ♀ is hardly produced at all. The second segment, in both sexes, bears a transverse row of 3 hairs, the third hair being long, while the others are much shorter than in the other species of *Loemopsylla*, there being also 2 short thin hairs at the hind edge of the segment. In the ♀ this segment differs from that of other species in the apical,

narrowed, portion being longer. The rostrum is longer than the maxillary palpi, reaching to the apical third of the forecoxa.

Thorax. The three thoracical tergites bear, on the two sides together, 14, 10 or 12, and 12 bristles respectively. There are 6 bristles on the pleura of the mesothorax, while the epimerum of the metathorax bears 10 or 11 bristles in two rows (5 to 7, 4 or 5).

Abdomen. The first tergite bears two rows of bristles, the first row consisting of 5 to 7, and the second of 6 bristles. The rows of bristles on the second to sixth tergites extend much further down the sides than in the other species of *Loemopsylla*, their number being in the ♂ 14 to 16, in the ♀ 18 to 20, on the two sides together, the seventh tergite having 10 to 11 bristles. The dorsal subapical bristle of this tergite is longer than the first and second midtarsal segments together. On the sternites there are in the ♂ 4 bristles, in the ♀ 8, the basal sternite having only 2 bristles in both sexes. The ventral line of this sternite is, in side-view, more oblique proximally than in the other species, being rather sharply curved near the apex.

Legs. The forecoxa bears about 30 bristles. The midcoxa is very strongly rounded behind, being almost as broad as it is long. The hindcoxa is likewise rounded and broad, bearing a comb of 4 to 6 spines. The mid- and hindfemora have on the outside 2 (occasionally 3) ventral subapical bristles and one lateral subapical one, there being only one bristle on the inside, the usual lateral row of bristles being absent. The hindfemur, moreover, has a very characteristic shape (Pl. II, fig. 7), its widest point lying further back than in the other species of *Loemopsylla*. The hindtibia bears a lateral row of 6 to 7 bristles and 2 additional ones in between this row and the dorsal bristles. The tarsi bear more bristles on the outer surface than in the other species of *Loemopsylla*. The longest apical bristle of the second hindtarsal segment reaches just beyond the apex of the fourth segment. While the first hindtarsal segment of the other species of *Loemopsylla* bears 5 to 7 bristles close together on the inside at the apex (see Pl. I), in *chephrenis* one bristle only exists in their place. The first pair of lateral bristles of the fifth foretarsal segment is placed nearer the mesial line than the other bristles. This segment bears in the ♂ 3 short stout apical ventral bristles; in the ♀ it has 2 apical bristles instead, one on each side, both being rather thin, the fifth segment of the mid- and hindtarsi bearing in both sexes only 2 such bristles.

Modified segments. ♂. The eighth sternite bears on each side one lateral and two ventral bristles. The clasper has two free slender pro-

cesses, the smaller one bearing one long apical bristle and some shorter ones. The manubrium is slightly club-shaped. The ninth sternite is canoe-shaped in side-view, narrowing rather strongly basally.—♀. The eighth tergite has, on the outside, 3 long lateral bristles and a subapical row of 5 to 7, there being 4 to 6 short apical bristles on the inside.

Length. ♂ 1·4 mm., ♀ 2·2 mm.

We have a small series of both sexes from Cairo, Egypt, off *Acomys cahirinus* and *Jaculus jaculus*[1], taken in January and March, 1901, by N. C. Rothschild and A. F. R. Wollaston.

We also received a pair of cotypes of *alternans* Wahlgr. from the Riksmuseum at Stockholm.

5. *Genus:* **Rhopalopsyllus** *Baker* (1905).

Rhopalopsyllus Baker (1905*a*, p. 128, type of name: *lutzi*; descript. erroneous); Rothschild (1906, p. 173).

The short description which Baker gave of his genus *Rhopalopsyllus* is erroneous and insufficient. From the incidental statement, however, on page 130 of the treatise quoted above that "the upper edge of the antennal groove usually has a row of many short and thick, but minute, spines or teeth," we may safely conclude that the name *Rhopalopsyllus* was meant to apply as a generic term to the species characterised below.

Head. Frons always with notch (Pl. II, fig. 3). Antennal groove extended to the vertex in both sexes, widely open behind, the genal process being short (Pl. II, fig. 3). First segment of the antennae long in ♂ and ♀; second almost square in side-view, bearing several bristles at the hinder edge, the last bristle being the longest and stoutest; club a little longer in ♂ than in ♀, segmented all round, the segments deeply separated on hinder side, the first elongate-ovate, the next three lamelliform in lateral aspect, separate, very oblique in position, inclining apicad (Pl. II, fig. 3). In both sexes a row of short, stout, spine-like hairs along the antennal groove, standing close together, the row extending from the hinder edge of the head to the central row of bristles of the occiput. Occiput with at least one row of bristles besides the subapical row. Labial palpus consisting of 5 to 7 segments; the segmentation very distinct all round; tip of last segment excised, bearing 3 small hairs on each side (Pl. II, fig. 9). There are 3 bristles

[1] The specimen of *Jaculus jaculus* from which a *L. chephrenis* was taken had been kept in captivity for two days in a cage with a live *Acomys cahirinus*. This flea is probably confined to *A. cahirinus*.

in front of the eye and usually another row farther frontad. One or more bristles beneath the eye.

Thorax. Upper edge of prosternum subangulate before middle (Pl. II, fig. 3). Pronotum with two rows of bristles, meso- and metanotum with three or more rows. Mesonotum without subapical spines. Metanotum as well as the anterior abdominal tergites bearing a comb of very small teeth at the apical edges. Epimerum of mesothorax more or less completely covering the stigma. Episternum of metathorax large, more than half the size of the sternum (side-view), bearing two long bristles, one at upper margin and one at lower, besides some small hairs. Sternum of metathorax with one short bristle. Epimerum of metathorax with two rows of bristles, the anterior row being situated at some distance from the stigma, while the second row extends from the stigma downwards.

Abdomen. Tergites with at least two rows of bristles, but the anterior row sometimes represented by a few dorsal bristles only; seventh tergite bearing a long bristle at the apical edge, placed on a cone, the edge of the segment being here sinuate, projecting backwards dorsally in between the long bristles (Pl. VI, fig. 7). Basal sternite in ♂ and ♀ with small hairs on the side. Stigmata large. Anal segment large, especially the sternite.

Legs. Internal rod-like incrassation of midcoxa dividing about the centre, at any rate farther from the base than in *Pulex* and *Loemopsylla*. No comb on hindcoxa. First segment of fore- and midtarsi shorter than the second. Hindfemur bearing at least one row of bristles on the outer surface. Fifth tarsal segment (Pl. III, fig. 10) with 4 lateral bristles besides the subapical hair, and with a row of 2 to 4 small hairs on the ventral surface.

Modified segments. ♂. Clasper large, triangular, bearing a long finger-like movable process (Pl. VI, fig. 7, F). Ninth sternite boomerang-shaped, the inner vertical portion extending upwards beyond the manubrium of the clasper and being widened at apex.— ♀. Eighth tergite always with some bristles above the stigma (Pl. VII, fig. 10).

The genus is purely American. It contains at present twelve species, one of them (*lutzi*) being doubtfully distinct from *cleophontis*.

Key to the species of Rhopalopsyllus.

a. Labial palpus consisting of 6 or 7 segments .....b
Labial palpus consisting of 5 segments .....e
b. Metanotum with 3 rows of bristles .....Species No. 1
Metanotum with 2 rows of bristles .....Species No. 2
c. Rostrum extending beyond the trochanter .....Species No. 10
Rostrum extending to the apex of the forecoxa or being shorter .....d
d. Occiput with 2 rows of bristles .....Species No. 11
Occiput with 3 rows of bristles .....e
e. Anterior edge of pygidial plate much raised, projecting ; fifth segment of all tarsi long, dilated towards apex, that of foretarsus larger than the second midtarsal segment .....f
Anterior edge of pygidial plate slightly raised ; fifth tarsal segment short, in hindtarsus about as long as the second midtarsal segment .....h
f. Basal abdominal sternite with 2 lateral rows of small bristles .....g
Basal abdominal sternite with 3 or 4 irregular lateral rows of small bristles. Species No. 5
g. Hindtibia with 2 or 3 bristles on the inner surface .....Species No. 3
Hindtibia with 4 or 5 bristles on the inner surface .....Species No. 4
h. Midtibia with numerous bristles scattered over the outer surface as on the foretibia. Clasper of ♂ with 3 long bristles below the tip i
Midtibia with one lateral row of bristles on the out- and inside. Clasper of ♂ with 2 bristles below the tip.....Species No. 12
i. Hindcoxa with 2 bristles posteriorly near the apex ; the long bristle situated in the fourth notch of the hindtibia extending beyond the apex of the tibia. Species No. 9
Hindcoxa with 3 bristles posteriorly near the apex .....k
k. Metanotum with 4 rows of bristles, the anterior row consisting of about 6 bristles ..... Species No. 6
This fourth row of bristles of the metanotum absent, or represented by 1 or 2 bristles only l
l. The bristles situated below the tip of the ninth sternite (♂) very numerous; movable process of elasper short .....Species No. 8
The bristles situated below the apex of the ninth sternite (♂) more evenly distributed ; movable process of clasper long and slender .....Species No. 7

(1) Rhopalopsyllus cleophontis *Rothsch.* (1904).

(Pl. II, figs. 3, 9; III, fig. 10; VI, fig. 7.)

Pulex cleophontis Rothschild (1904 *a*, p. 614, n. 9, t. 10, fig. 32, Buenos Ayres, off *Muletia septemcincta*).
Rhopalopsyllus cleophontis Baker (1905 *a*, pp. 130, 143).

The largest known species of this genus, apart from *R. lutzi*. The bristles on the body are somewhat thin for the size of the insect.

Head. The labial palpus has six segments, sometimes one or the other segment being again divided on one side. The basal segment (= labium) of the rostrum is very short. The anterior row of bristles of the frons (Pl. II, fig. 3) is represented by 3 or 4 thin bristles (in the original description it was erroneously stated that this anterior row is absent). The bristle situated at the apex of the second antennal segment is very thick.

Thorax. The pro- and mesonotum bear each two rows of bristles, the posterior row consisting of 12 or 13 bristles. On the metanotum there are three rows. The pleura of the mesothorax bears 4 bristles, while the epimerum of the metathorax has 10 or 11 bristles in two rows (4 to 6, 4 to 6).

Abdomen. The first abdominal tergite has a comb of short apical spines like the metanotum, the second and third, and sometimes the fourth and fifth tergites also bearing some apical spines. The first tergite has two rows of bristles, the anterior row consisting of about 12, the posterior row of 8 bristles. The second to seventh tergites have a posterior row of 12 bristles, one anterior row being represented in the ♂ on the second tergite by 4 or 5 bristles, on the two sides together, and by 2 to 4 bristles on the other tergites, while the numbers are somewhat increased on the proximal tergites of the ♀, there being in this sex also a bristle just beneath the stigma. The basal sternite bears two lateral rows of hairs, besides some ventral bristles. The second sternite has a row of about 10 bristles and one or two additional bristles in front of this row, the number of bristles being smaller on the sternites of the fourth to sixth segments. In the sternite of the seventh segment there is a row of 7 to 10 bristles, the ♀ having ventrally 2 or 3 bristles in front of this row.

Legs. The forecoxa bears more than 30 bristles, the bristles being closer together near the base than near the apex of the coxa. The midcoxa has bristles on both sides along the anterior edge from the base to the apex. On the inside of the hindcoxa there is a row of bristles along the anterior edge, the bristles being closer together towards the apex than towards the base of the coxa. There are 3 bristles posteriorly at the apex of the hindcoxa, and 2 on the midcoxa. The hindfemur bears on the inside a row of 8 or 9 bristles, there being on the outside 2 subapical ventral bristles and 2 or 3 anterior lateral ones, besides a few dorso-lateral hairs. The hindtibia bears 9 bristles on the outer side, besides about 12 shorter ones which stand at and near the anterior edge of the tibia. The tarsi and their bristles are

very robust, the fifth segment (Pl. III, fig. 10) especially being long and broad. In the foretarsus this segment is as long as the four other segments together, its lateral bristles as well as the claws being long and strong. The second midtarsal segment is nearly twice the length of the first. The proportional lengths of the mid- and hindtarsal segments are:

Segment		First	Second	Third	Fourth	Fifth
Midtarsus:	♂	18	31	18	9	40
	♀	19	37	20	12	48
Hindtarsus:	♂	50	44	27	14	46
	♀	60	50	30	14	50

Modified segments. ♂. The eighth sternite bears a row of about 12 bristles on both sides together, the ventral bristles of this row being smaller than the lateral ones, there being also some small hairs in front of the row. The clasper is triangular (Pl. VI, fig. 7), with the apex rounded off. There are 3 long stout bristles close together below the apex and a thinner and paler one above them at the apex, there being also a number of bristles and hairs along the dorsal edge of the clasper. The finger (F) is long and slender, almost reaching to the subapical bristles of the clasper. The finger bears 2 long thin bristles near the apex, besides a number of thin hairs. Where the finger joins the clasper there are 4 bristles (3, 1) at the ventral margin of the clasper. The manubrium of the clasper is slender. The ninth sternite (ix. st.) is elongate boat-shaped, bearing a number of bristles in the apical half along the ventral margin, two of them being somewhat thicker and longer than the others.— ♀. There are 3 small bristles above the stigma of the eighth tergite on each side. From the stigma downwards this segment bears a row of 12 to 14 bristles, the row being widely interrupted beneath the centre. There is a row of about 12 bristles along the apical edge on the outside, five or six of the apical bristles being close together, and a row of about 12 on the inside. On the outside of the segment, near the base, there is a patch of 3 to 5 small bristles. The stylet is cylindrical, or nearly so, bearing a long apical bristle, but no subapical notch.

Length. ♂ 2·6 to 2·9 mm., ♀ 2·6 to 3·7 mm.[1]

We have 2 ♂♂ and 2 ♀♀ from the southern portion of the Province of Buenos Ayres, from *Muletia septemcincta*, collected by the late Dr

[1] Some of the mounted specimens are much extended, which partly accounts for the difference in length.

Carlos Berg; and several pairs from Minas Geraës (A. Kennedy), no host being given.

The large development of the fifth tarsal segment is suggestive of the genus *Malacopsylla* Weyenb.

We also have a ♂ and a ♀ from Sapucay, Paraguay, off *Didelphys spec.*, collected by W. Foster, the ♂ differing from the above described ♂♂ in the clasper bearing but 3 bristles at the tip.

(2) **Rhopalopsyllus lutzi** *Baker* (1904).

Pulex lutzi Baker (1904, pp. 378, 380, São Paulo, off *Grison vittata*).
Rhopalopsyllus lutzi Baker (1905 *a*, pp. 128, 130).

We have not seen Dr Baker's specimens, and therefore must rely on the description he gives. Unfortunately the description appears to be very faulty, some of the statements at least being certainly incorrect. In 1904 the palpus is said to be "apparently six-jointed," while it is stated to be four-jointed in 1905.

The metanotum is described as having only two rows of bristles like the pro- and mesonotum, a statement which requires verification. Only the first and second abdominal tergites have the second row of smaller bristles, the remainder having each but a single row of about 13 bristles. The frontal portion of the head bears two rows of bristles, the anterior row consisting of 4 smaller bristles, the second row of 3 much larger ones. The clasper appears to be similar to that of *R. cleophontis*, being "armed at the tip with 3 stout close set spines." The stylet of the ♀ is cylindrical. The hindtibia has about 8 stout bristles on the outer side.

Length. ♂ 5·5 mm., ♀ 6 mm.

Both sexes from São Paulo, off *Grison vittatus*, in the United States National Museum.

We believe this insect to be a near ally of *R. cleophontis*.

(3) **Rhopalopsyllus australis** *Rothsch.* (1904).

(Pl. III, fig. 11; VI, figs. 10, 11.)

Pulex australis Rothschild (1904 *a*, p. 613, n. 8, t. 9, fig. 29, t. 10, figs. 34, 36, partim, Tabasco, Mexico, off *Dicotyles labiatus*).
Rhopalopsyllus australis Baker (1905, pp. 130, 143).

Head. The first segment of the maxillary palpus is as long as the third, the second being a very little shorter than the fourth. The

rostrum does not reach to the apex of the forecoxa. The labial palpus has five segments. The frons bears two rows of bristles, those of the anterior row being short and rather thin, except the one which is situated near the antennal groove. There are three rows of bristles on the occiput.

Thorax. The pronotum has two rows of bristles (8, 15), the mesonotum also two (13 to 16, 15), and the metanotum four rows (5 to 10, 20, 20, 15 to 17). There are 4 bristles on the pleura of the mesothorax, while the epimerum of the metathorax bears 10 to 12 bristles in two rows (5 or 7, 4 to 6), there being no bristles close to the upper anterior corner of this sclerite.

Abdomen. The first tergite has two rows of bristles (12 and 8 or 10); on the second tergite there are about 8 small bristles in the anterior row and 12 in the posterior series. The third to seventh tergites have in the ♂ from 0 to 3 bristles in the anterior series and 12 in the posterior, while the numbers in the ♀ are 4 and 14, the seventh tergite bearing in this sex a row of 9 or 10 bristles and in front of it about 7 small ones. On the basal sternite there are two lateral rows of hairs. The sternites of the third to seventh segments bear in the ♂ 4 long and some small bristles and in the ♀ 8 long bristles on the two sides together, the second sternite having some additional hairs in front of the row in both sexes. The first tergite, like the metanotum, has a comb of short apical spines, the following four tergites also bearing from 1 to 3 small spines. The edge of the pygidial plate is strongly raised anteriorly, projecting backwards in a side-view.

Legs. The hindcoxa has 3 bristles posteriorly at the apex. The femora bear two rows of bristles on the outside, the upper row of the hindfemur being restricted to the posterior half of the femur. The forefemur has on the inside only 2 small bristles, one situated nearly in the centre, the other ventrally near the apex. The hindfemur bears on the inside a row of 7 or 8 bristles. The bristles of the tibiae and hindtarsi are long and thick. The hindtibia bears about 12 short bristles at and near the anterior side, while there are usually 10 longer ones on the lateral surface. In the ♀ the longest apical bristle of the hindtibia reaches to the apex of the first hindtarsal segment, the longest bristle of this segment extending to the tip of the second segment, and the longest bristle of the second segment to the apex of the fourth, these bristles being somewhat longer in the ♂. The fifth tarsal segment is large, the claws being also very long, this segment of the hindtarsus being as long as the first and second segments of the midtarsus together (Pl. III, fig. 11).

The measurements of the mid- and hindtarsi together are :

Segments		First	Second	Third	Fourth	Fifth
Midtarsus :	♂	14	23	14	9	30
	♀	16	26	18	10	36
Hindtarsus :	♂	49	35	22	13	39
	♀	52	38	23	13	40

Modified segments. ♂. The eighth sternite bears a row of about 9 rather short bristles on the two sides together. The large clasper bears 2 stout bristles below the tip and a number of slenderer bristles at and near the upper edge. The movable "finger" is elongate-rectangular, the apex being slightly rounded. At the edge of the clasper near the base of the finger there are 3 thin bristles (2, 1). The external (ventral) portion of the ninth sternite (Pl. VI, fig. 11) gradually narrows towards the apex, bearing a number of slender bristles and hairs.—♀. The eighth tergite has 1 to 3 bristles above the stigma. There is a row of 4 long and 5 or 6 short bristles extending from the stigma downwards and an additional row of about 12 bristles along the apical edge on the outside, 4 of the apical bristles being long and placed close together. On the inside of the segment there are about 9 bristles. The stylet is cylindrical.

We have a series of both sexes from :

Santa Andrea, Tabasco, Mexico, off *Dicotyles labiatus*, May 1897, collected by Dr Buller.

Charuplaya, Bolivia, off *Speothos vinaticus*, June 1897, collected by P. O. Simons.

San Bernardino, Paraguay, off *Dasyprocta aguti*, May 1906, collected by Karl Fiebrig.

Minas Geraës, Brazil, no host, collected by A. Kennedy.

In the ♂♂ from Brazil and Paraguay the ninth abdominal sternite is longer, bearing fewer hairs proximally and more distally (Pl. VI, fig. 10) than in Mexican specimen.

(4) **Rhopalopsyllus cacicus** *spec nov.*

(Pl. III, fig. 13; VI, fig. 8.)

Pulex australis Rothschild (1904*a*, p. 613, n. 8, partim, Perené).

Nearly related to *R. australis*, but differing in the following characters :

Head. The rostrum reaches to the apex of the forecoxa, the last

segment being somewhat shorter than the two preceding segments together. The second segment of the maxillary palpus is longer than in *R. australis.*

Thorax. The epimerum of the metathorax bears 6 or 7 bristles in two rows (3, 4; or 3, 3).

Legs. The mid- and hindtibiae bear a row of 4 or 5 bristles on the inner surface. The second midtarsal segment (Pl. III, fig. 13) is considerably longer than in *R. australis.* The bristles of the tarsi are shorter, the longest apical bristle of the first hindtarsal segment not reaching to the apex of the second segment, while the longest bristle of the second segment only reaches to the apex of the third. The longest apical bristle of the fourth hindtarsal segment hardly extends to the base of the third pair of bristles of the fifth segment.

Modified segments. ♂. The clasper bears near the insertion of the "finger" 4 bristles (3, 1), besides 2 small hairs. The ninth sternite (Pl. VI, fig. 8) is broader than in *R. australis* and bears many more hairs, one of them being long, while all the other ventral ones are short.

We have two ♂♂ from Perené, Peru, taken off *Tatusia novemcincta* by P. O. Simons.

(5) **Rhopalopsyllus lugubris** *spec. nov.*

(Pl. III, fig. 12; VI, fig. 9.)

Larger than *R. australis,* to which it is closely allied.

Head. The last segment of the rostrum is longer than the two preceding ones together. The second segment of the maxillary palpus, as in *R. cacicus,* is much longer than the fourth.

Thorax. The anterior row on the pronotum contains about 10 bristles on the two sides together. The epimerum of the mesothorax bears 4 long bristles, 2 of which are placed above the stigma, besides 2 or 3 short ones situated in front of the meral suture.

Abdomen. The basal abdominal sternite bears about 17 short bristles on the lateral surface, arranged in three irregular rows, while the second sternite has on each side 3 or 4 short bristles in front of the postmedian row.

Legs. The hind margin of the hindcoxa is much less rounded than in the allied species. The midfemur bears about 24 bristles on the outside and the hindfemur about 18, arranged in three irregular rows. The bristles on the outside of the mid- and hindtibiae are more numerous than in *R. australis* and *cacicus,* the hindtibia bearing about

18 bristles. The hairs on the outside of the tarsi are likewise more numerous. For the first and second midtarsal segments see Pl. III, fig. 12.

Modified segments. ♂. The eighth sternite is ventrally produced. The bristles at and near the dorsal edge of the clasper are more numerous than in the two preceding species, the ventral edge bearing 3 bristles distally to the insertion of the "finger," and one proximally to it. The ninth sternite has one small bristle at the apex and 3 long ones before it, the most proximal one of the three being the longest, there being also some more small bristles further proximad (Pl. VI, fig. 9).

Length. ♂ 2·6 mm.

One ♂ from Charuplaya, Bolivia, found by P. O. Simons on *Speothos vinaticus*, together with a ♂ of *R. australis*, January 1897.

In contradistinction to the five preceding species in which the fifth tarsal segment is long (Pl. III, fig. 10), in all the following species this segment is short (Pl. IV, fig. 4).

(6) **Rhopalopsyllus bohlsi** *Wagn.* (1901).

(Pl. IV, fig. 4; VII, fig. 7.)

Pulex bohlsi Wagner (1901, p. 21, n. 5, t. 1, fig. 6, ♀, Paraguay, 1 ♀).
Rhopalopsyllus bohlsi Baker (1905 *a*, pp. 130, 143).

Head. The frons bears an anterior row of 5 or 6 bristles which are very much thinner and shorter than the 3 eye-bristles. The first row of the occiput consists of 12 to 14 slender bristles, the second row of 16 and the third of 14 to 16, on the two sides together. In the ♂ there are, moreover, numerous short slender bristles in the dorsal groove of the occiput.

Thorax. The pronotum has two rows of bristles, the first consisting of about 16, the second of about 18 bristles, on the two sides together, not counting the small hairs which are situated in between the bristles of the second row. The numbers of bristles in the two rows of the mesonotum are about 22 and 16 respectively. The metanotum has three rows of about 16, 26, 16 bristles. On the pleura of the mesothorax there are 5 bristles, while the epimerum of the metathorax bears 10 or 11 in two rows (6 or 7, 4 or 5). The metanotum has 10 to 15 short apical spines.

Abdomen. The tergites bear each two rows of bristles, the anterior segments having a few additional bristles on the back. The numbers of bristles in these rows are:—i. 16 to 22, 12 or 13; ii. 22, 19 to 21; iii. 22 to 24, 19 or 20; iv. 18 to 21, 18 to 20; v. 15 or 16, 18 to 20; vi. 11 in ♂,

16 in ♀, 16 or 17; vii. 10 in ♂, and 13 or 14 in ♀, 12 to 14. On the sternites of the third to seventh segments there are in the ♂ 11, 12, 10, 10, and 10 bristles respectively, the numbers being in the ♀ 14, 12, 10, 11 to 13, and 15 on the two sides together, the seventh sternite having on each side 5 or 6 additional bristles in front of the row. There are also some small bristles before the row of long ones on the sternite of the third segment in the ♀. The basal sternite bears on each lateral surface in the ♂ about 5 hairs, in the ♀ 12 to 16, the segment having also along the ventral line 5 to 9 short hairs. The proximal tergites bear short apical spines, the numbers being in the ♂ 13, 8, 5, 4, 1 and in the ♀ 11 to 16, 5 or 6, 3 to 6, 3 or 4.

Legs. The forecoxa bears more than 50 bristles. The fore- and midfemora have a number of short bristles scattered over the outer surface, besides some longer subapical bristles. There is a row of about 8 bristles on the outer side of the hindfemur, and a row of 4 to 6 on the inside. The hindtibia bears 30 odd bristles on the outer side, inclusive of those placed at the anterior edge, the bristles being slightly more numerous in the ♂ than in the ♀. The longest apical bristle of the second hindtarsal segment does not reach to the middle of the fourth segment. There are 2 ventral apical bristles on the fifth segment, one being long the other short and stout, the fourth lateral pair, which stands close to these apical bristles, being also short, strong, and blunt. The fifth segment of the hindtarsi is about as long as the second midtarsal one (Pl. IV, fig. 4).

Modified segments. ♂. The eighth sternite bears on each side a row of 5 bristles, in front of which there are several smaller bristles. The triangular clasper (Pl. VII, fig. 7) bears a long bristle beneath the apex and about 9 medium-sized bristles along the upper edge, besides several small ones. At the ventral edge, not very far from the long subapical bristle, the clasper has a notch, the "finger" extending beyond this notch. The ninth sternite bears about a dozen bristles, one of which is much longer than the others. The manubrium of the clasper is somewhat widened at the apex.— ♀. The eighth tergite bears 6 to 8 hairs above the stigma, of which the one nearest the apex is the longest, corresponding to the long subapical bristle of the seventh tergite. From the stigma downwards there is a row of 7 long and 14 short bristles, the segment bearing basally at some distance from that row a patch of about 5 short bristles. Along the ventral and apical edges there are 18 to 20 long and short bristles. The stylet is slightly bottle-shaped, bearing a small notch near the apex.

Length. ♂ 2·2 mm., ♀ 2·4 mm.

We have not seen the specimen described and figured by Wagner, but we believe we have correctly identified as *bohlsi* the undermentioned specimens received from Paraguay, Argentina and Ecuador.

One ♂ from Paraguay, off *Didelphys azarae*, Dec. 1901; W. Foster.

Two ♀♀ from Sapucay, Paraguay, off *Didelphys azarae*; W. Foster.

Two ♀♀ from Gran Chaco, Argentina, off *Didelphys azarae*, May 1900; Mr Pride (per J. Graham Kerr).

One ♀ from Ibarra, Ecuador, off *Nectomys saturatus*, May 1897; W. F. H. Rosenberg.

(7) **Rhopalopsyllus roberti** *Rothsch.* (1905).

Pulex roberti Rothschild (1905, p. 479, n. 1, t. 13, figs. 1, 2, São Paulo, off *Nectomys* and *Didelphys*).

Closely related to *R. bohlsi*; but *roberti* is larger than that species, and the bristles are much stouter, especially those situated on the head. There is an additional row of bristles dorsally in front of the two rows of the mesonotum and of the three rows of the metanotum. The long ventral apical bristle of the fifth foretarsal segment is stouter than in *R. bohlsi*. The apical bristles of the second hindtarsal segment are somewhat shorter than in that species. The eighth sternite of the ♂ bears on each side a curved row of 5 or 6 bristles, there being no additional bristles in front of this row. The bristles on the dorsal side of the clasper are fewer in number than in *R. bohlsi* and there is a long bristle at the point where the clasper joins the dorsal portion of the ninth segment. The bristles of the ninth sternite of the ♂ are all practically of the same length. In the ♀ the seventh abdominal sternite bears a single row of long bristles, there being no bristles in front of the row, and the eighth sternite has fewer bristles than in *bohlsi*.

We have both sexes from São Paulo, Brazil, off *Didelphys aurita*, found in November 1901 by A. Robert.

(8) **Rhopalopsyllus bernhardi** *spec. nov.*

(Pl. VII, fig. 6.)

Likewise very closely related to *R. bohlsi*. The first midtarsal segment is somewhat shorter. The clasper of the ♂ bears fewer bristles than in *R. bohlsi* and *roberti*, there being a large bristle (broken in our single specimen) where the clasper joins the dorsal portion of the ninth

segment. The "finger" of the clasper is one-fourth shorter than in *bohlsi* and *roberti*, and its bristles are placed closer together in the centre of the ventral margin. The manubrium is slenderer than in the allied species. The ninth sternite of the ♂ is very robust (Pl. VII, fig. 6). It is rounded at the apex, not bearing any bristles at the extreme tip, while the ventral bristles placed on the inner side close to the apex are very numerous. One of the bristles of the outside is longer than the others, as is the case in *R. bohlsi*.

With this ♂ a ♀ was sent which may belong to the same species, though it does not apparently differ from the ♀ of *R. bohlsi* except that the first midtarsal segment is slightly shorter, as is the case also in the ♂ of *bernhardi*.

One ♂ and one ♀ off a species of *Didelphys*; San Bernardino, Paraguay, May 1906, collected by Herr Karl Fiebrig.

(9) **Rhopalopsyllus platensis** *spec. nov.*

(Pl. VII, fig. 10.)

We have only one ♀ of this insect.

The rostrum reaches to the trochanter, being a little longer than in the ♀ ♀ of the allied species. The maxillary palpus is also longer, the segments measuring 20, 26, 14 and 26 respectively. The pleura of the mesothorax bears 6 bristles. The hindcoxa has only 2 bristles posteriorly at the apex. There are 24 bristles on each lateral surface of the basal abdominal sternite, besides the bristles which are situated at the ventral margin. The hindfemur bears on the outside a row of 9 or 10 bristles, and on the inside a row of 8. The bristles on the outside of the hindtibia are less numerous than in the allied species. The long bristle situated in the fourth incision of the hindtibia reaches far beyond the apex of the tibia. The longest apical bristle reaches beyond the tip of the first tarsal segment, the longest bristle of this segment extending beyond the apex of the second segment, while the corresponding bristle of the second segment extends close to the apex of the fourth segment. The bristles on the seventh abdominal sternite and the small lateral ones which stand on the eighth tergite (Pl. VII, fig. 10) basally to the lateral row are more numerous than in *R. bohlsi*.

One ♀ off *Ctenomys spec.* from La Plata, collected by Dr Spegazzini, and received from the late Dr C. Berg.

(10) **Rhopalopsyllus cavicola** *Weyenb.* (1881).

(Pl. IV, fig. 3.)

Pulex cavicola Weyenbergh (1881, p. 274, Argentina, off *Cavia leucopyga*); Rothschild (1906, p. 174, n. 3=*concitus*).

Pulex concitus Rothschild (1904*a*, p. 615, n. 10, t. 10, figs. 38, 40, Bolivia, off *Herodon boliviensis*).

Rhopalopsyllus concitus Baker (1905*a*, pp. 130, 143).

We only know the ♀ of this insect. The species is easily distinguished by the very long rostrum.

Head. The labial palpus consists of 5 segments, reaching beyond the apex of the trochanter. The first segment of the maxillary palpus is a little shorter than the second, while the third is one-third, or a little over one-third, the length of the fourth. The anterior frontal row of bristles contains 6 to 8 rather thin bristles, the fifth being the longest. There is one bristle beneath the eye, one behind the eye, and a row of 3 in front of it. The occiput bears three rows of rather slender bristles.

Thorax. The posterior row on the nota consists of 14 bristles, the anterior row of the pro- and mesonotum containing 12 bristles on the two sides together. On the metanotum there is a third row of about 9 bristles in front of the other two, the second row consisting of about 15. The pleura of the mesonotum has 3 or 4 bristles, and the epimerum of the metathorax 7 or 8 in two rows (3 or 4, 4).

Abdomen. The tergites have all two rows of bristles. The first tergite, like the metanotum, bears a comb of short apical spines, there being also some spines on the following segments. The basal sternite has a lateral patch of about 15 to 20 small hairs, the segment bearing also some bristles ventrally near the apex. The next sternite has a row of 10 to 12 bristles on the two sides together, there being several short additional hairs in front of the row. On the sternite of the seventh segment there is a curved row of 6 or 7 bristles on each side, with some small ones in front. The apical bristle of the seventh tergite is longer than the first and second midtarsal segments together.

Legs. The forecoxa has less than 30 bristles. The midcoxa bears about 12 bristles along the anterior edge, apart from those which stand at the apical margin. The hindcoxa has 2 bristles posteriorly at the apex. The mid- and hindfemora bear one row of bristles on each side. The hindtibia has 12 bristles on the outer surface, besides 3 to 6 short ones, which are placed along the anterior margin. The apical bristles of the tibiae are long and rather thin, the longest one of the hindtibia

reaching to the apex of the first hindtarsal segment. The fifth segment is short, being in the foretarsus (Pl. IV, fig. 3) half as long again as it is broad. The measurements of the mid- and hindtarsi are as follows:

Segment	First	Second	Third	Fourth	Fifth
Midtarsus:	15	19	11	7	22
Hindtarsus:	38	26	17	9	24

Modified segments. ♀. The apical margin of the eighth tergite is rounded, bearing on the outside a regular row of 7 to 9 long bristles and on the inside about a dozen shorter ones. There is on the outside a row of 3 or 4 long and 4 to 7 short bristles running from the stigma downwards, while there are usually 4 bristles above the stigma, the apical one being the largest. The stylet is short, being about half as long again as it is broad.

Length. ♀ 2·4 mm.; an exceptionally small specimen from Bolivia 1·7 mm.

We have 6 ♀♀ as follows: two cotypes of *cavicola* from the collection of the late Professor Weyenbergh; and four specimens from Sucre, Bolivia, off *Herodon boliviensis*, 6th September, 1901, collected by P. O. Simons.

(11) **Rhopalopsyllus litus** *spec. nov.*

This is the only known species of *Rhopalopsyllus* in which the occiput bears only two rows of bristles.

Head. The bristles are slender. The anterior row of the frons consists of 5 bristles. The bristles situated beneath and behind the eye are apparently small (they are broken off in our two specimens). The anterior row of bristles of the occiput is absent. The second row contains only 2 fairly long bristles and 1 or 2 small hairs. The rostrum reaches the apex of the forecoxa, the labial palpus consisting of five segments. The first segment of the maxillary palpus is longer than the third, the second being a little shorter than the fourth.

Thorax. The posterior row of bristles on the nota consists of 14 bristles, the antemedian row containing on the pronotum about 12 small bristles and on the meso- and metanotum about 18, the metanotum bearing an additional row of 8 or 9 short bristles. There are 5 long bristles on the pleura of the mesothorax and 8 to 11 bristles in two rows on the epimerum of the metathorax (4 to 6, 4 or 5).

Abdomen. The first tergite has, like the metanotum, the usual comb of short apical spines, a few such spines occurring also on the next two or three tergites. There are two rows of bristles on the tergites, the first row containing in our two specimens 12 and 13, 16 and 22, 14 and 20, 12 and 19, 11 and 19, 10 and 11, 8 and 10, bristles respectively, the second row consisting of 10 and 11 bristles on the first segment, 16 and 17 on the second to fifth, 13 and 11 on the sixth, and 13 and 14 on the seventh respectively. The apical bristle of the seventh tergite is as long as the first and second midtarsal segments together. The basal sternite bears a large patch of small hairs on the side. The next sternite has a row of 14 or 18 bristles on the two sides together, the upper bristles being short and there being also several short bristles in front of the row. The sternites of segments 4, 5 and 6 bear each a row of 8 or 12 or 14 bristles, the seventh sternite having a row of about 12 and ventrally in front of the row 4 or 6 more. As in *cavicola* the edge of the pygidial plate is only slightly raised anteriorly, projecting much less than in *R. australis*.

Legs. The forecoxa bears about 40 bristles. The hindcoxa has 3 bristles posteriorly at the apex. The mid- and hindfemora bear a row of bristles both on their inner and outer sides, there being a number of additional bristles on the lateral outer surface of the midfemur and 1 to 3 subapical lateral bristles on the outside of the hindfemur. The hindtibia has about 10 lateral bristles on the outside and about 10 shorter ones along the anterior (= ventral) side. The longest apical bristle of the hindtibia does not reach to the apex of the first tarsal segment, while the longest apical bristle of the second hindtarsal segment extends to the base of the fourth segment. The third segment of the foretarsus and the fourth of the hindtarsus are much longer than they are broad, the third midtarsal segment being about twice as long as it is broad. The fifth tarsal segment is small, being in the foretarsus twice as long as it is broad. The measurements of the mid- and hindtarsi are in the larger and more hairy specimens (the type of name) 20, 29, 15, 9, 24, and 57, 41, 22, 12, 26, respectively; in the smaller specimens the segments measure in the midtarsus 17, 22, 12, 8, 21, and in the hindtarsus 46, 30, 17, 9, 22.

Modified segments. ♀. The eighth tergite bears 6 or 7 bristles above the stigma in the larger specimen, and 4 in the smaller one, the apical bristle being far stouter than the others. From the stigma downwards there is, in the larger individual, a row of 6 or 7 large bristles and 6 to 10 small ones, while there are about 10 bristles along the

ventral and apical margins on the outer side and about as many shorter ones on the inner side. The number of bristles is slightly smaller in the second specimen. Proximally to the lateral row there are some short hairs in both examples. The stylet is about twice as long as it is broad.

Length. ♀ 2·9 mm. and 2·3 mm.

We have two ♀♀ without host and locality, being most probably South American.

(12) **Rhopalopsyllus klagesi** *Rothsch.* (1904).

(Pl. VII, figs. 8 and 9.)

Pulex klagesi Rothschild (1904 *a*, p. 620, n. 14, t. 9, fig. 28, t. 10, figs. 34, 39, Caura R., Venezuela, off *Prochimys*).
Rhopalopsyllus klagesi Baker (1905 *a*, pp. 130, 144).

A small species with the spines of the head strongly developed.

Head. The rostrum does not quite reach to the apex of the fore-coxa, the labial palpus consisting of five segments. The first segment of the maxillary palpus is a little longer than the third, and the second longer than the fourth. There are two rows of bristles on the frons, besides a large bristle situated beneath the eye and another behind the eye. The occiput bears three rows of bristles.

Thorax. The pro- and mesonotum have two rows of bristles each, the first consisting in the ♀ of about 12, the second of 14 bristles. On the metanotum there are three rows of bristles (in ♀ 5 to 10, 16, 12). The ♂ has a few bristles less in these rows than the ♀. The pleura of the mesothorax has 5 strong bristles. The epimerum of the metathorax bears 7 to 9 bristles in two rows (3 to 5, 3 or 4), the first bristle of the anterior row being placed near the upper corner of the sclerite.

Abdomen. In the ♂ the anterior row of bristles consists of about 10 bristles on the first tergite, 6 on the second, and 1 or 2 on the third to seventh tergites, the posterior row containing 8 bristles on the first tergite, 14 on the second, and 13 or 12 on the others. In the ♀ the number of bristles in the anterior row of the four proximal tergites are about 12, 14, 12, 10, and on the fifth, sixth and seventh tergites 8, the posterior row consisting of 9 or 10 bristles on the first tergite, 14 on the next three, and 12 or 13 on the fifth to seventh. The first tergite bears an apical comb of short spines like the metanotum, the second to fifth, sometimes even sixth, having only one or more such spines. The basal sternite bears in the ♂ 1 to 4 minute

hairs on the side, and 8 to 10 in the ♀. On the sternites of segments three to six there is a row of 4 to 6 bristles on both sides together, the ♀ having 6 to 9 bristles, there being some additional hairs in front of the row on the sternite of the third segment. The sternite of the seventh segment has one or two bristles less than the preceding segment. The edge of the pygidial plate is very slightly raised anteriorly.

Legs. The forecoxa bears less than 30 bristles. The midcoxa has about 8 to 10 bristles at and near the anterior edge, there being no bristles on the inner surface. The hindcoxa has 3 bristles posteriorly near the apex and likewise no bristles on the inside near the anterior margin. The hindfemur has a row of 5 to 8 bristles outside and only 3 widely separated bristles inside. The hindtibia has 13 lateral bristles besides a number of small hairs which are placed at the anterior edge. The longest (ventral) apical bristle of the hindtibia extends in both sexes beyond the apex of the first hindtarsal segment, the longest bristle of this segment reaching in the ♂ beyond the apex of the second segment, but is somewhat shorter in the ♀. The fifth tarsal segment is short. In the foretarsus it is very broad, being about half as long again as it is broad, while in the hindtarsus it is very slender. The lateral bristles of this segment are rather thin and long, the third bristle extending close to the apex of the segment. The measurements of the mid- and hindtarsi are:

Segment		First	Second	Third	Fourth	Fifth
Midtarsus:	♂	13	24	15	9	21
	♀	18	31	19	9	25
Hindtarsus:	♂	40	34	18	10	24
	♀	52	42	24	12	29

Modified segments. ♂. The eighth sternite bears about 6 bristles on the two sides together. The clasper is acuminate (Pl. VII, fig. 8). It bears a number of hairs at the upper margin, 2 bristles beneath the apex and 3 thin hairs (2, 1) at the ventral margin near the base of the "finger" (F). The two posterior thin hairs were originally erroneously described as being situated on the finger. The manubrum (M) is slender. The finger reaches to the tip of the clasper. The ventral portion of the ninth sternite (ix. st.) is short and slender.— ♀. The eighth tergite is very strongly produced apically (Pl. VII, fig. 9). There are 3, 4 or 5 hairs above the stigma, one of them being thick. A row of 2 large and several small bristles extends from the

stigma downwards, 1 or 2 more large bristles being placed further ventrally. The ventral and apical edges also bear an irregular row of long and short bristles as shown in the figure. The stylet is cylindrical.

Length. ♂ 1·4 mm., ♀ 2·2 mm.

We have both sexes from Maripa, Caura River, Orinoco, off *Prochimys spec.*, May 1903, collected by S. M. Klages.

6. *Genus:* **Parapsyllus** *Enderl.* (1903).

Parapsyllus Enderlein (1903, p. 260, name-type: *longicornis Enderl.*); Baker (1905 *a*, p. 131).

♂♀. Nearest to *Rhopalopsyllus*, from which it differs especially in the antenna.

Head. The genal process short, obtuse, bearing a number of bristles (Pl. II, fig. 12). The antennal groove large, open behind, extending on to the prosternite. The club of the antenna long, resembling that of *Ceratophyllus* Curt., being acuminate in the ♂, with the last segment ovate and the segmental incisions distinct all round the club. The proximal segments of the club symmetrical, not being semi-detached and not sloping backwards as in *Rhopalopsyllus*. The short hairs situated at the upper edge of the antennal groove thinner than in *Rhopalopsyllus*, being in the ♀ few in number and placed widely apart. The labial palpus has 4 or 5 segments.

Thorax. The thoracical tergites bear two rows of bristles, there being usually some additional bristles on the meso- and metanotum. The metanotum has no apical spines. The episternum of the metathorax is smaller than in *Rhopalopsyllus*.

Legs. No comb of spines on the hindcoxa.

Abdomen. The stigmata are smaller than in *Rhopalopsyllus*.

Modified segments. These are of the same type as in *Rhopalopsyllus*; but in one species (*simonsi*) the clasper bears an additional process.

The species, as far as they are known, are so different from each other that they possibly represent four genera. These species are, however, more closely allied to one another than to the other non-combed eyed *Pulicidae* and, moreover, have some conspicuous characters in common, that we consider it unnecessary to propose several new genera for their reception. They will, therefore, be placed under Enderlein's generic term, till the discovery of a larger number of species renders it necessary to divide the genus.

The species are South American and Antarctic, one species (*longicornis*) going with its host (Penguin) northward to Australia.

Key to the species.

a. Labial palpus consisting of 4 segments .....Species No. 4
Labial palpus consisting of 5 segments .....b
b. Proximal segments of abdomen with apical spines .....Species No. 3
Proximal segments of abdomen without apical spines c
c. Mesonotum without thin bristle-like subapical spines .....Species No. 1
Mesonotum with thin bristle-like subapical spines .....Species No. 2

(1) **Parapsyllus longicornis** *Enderl.* (1901).

(Pl. II, fig. 12; IV, fig. 5; VII, fig. 3.)

Pulex longicornis (1901, p. 553, t. 34, figs. 8, 9, 12, S. Paul Is., off *Eudyptes "chrysocome"*).

Parapsyllus longicornis Enderlein (1903, p. 261, fig. 2, t. 39, figs. 13, 14, 16, 17, 19, 21); Baker (1905 *a*, p. 144).

Head. The frontal tubercle is large (Pl. II, fig. 12), being situated close above the frontal oral corner of the head. There is a row of bristles beneath the eye along the genal edge. The antennal groove is very large in the ♂, there being in both sexes a distinct internal incrassation of the skeleton from the base of the antennal groove upwards. The second antennal segment bears a row of long bristles along the apical edge, the bristles being especially long in the ♀, some of them reaching to the apex of the club in this sex. The rostrum extends to the trochanter, the labial palpi consisting of five segments.

Thorax. The mesonotum has no subapical spines. The epimerum of the metathorax bears a row of 3 or 4 bristles running from the stigma downwards, and 1 to 3 additional bristles representing an anterior row. The episternum of the metathorax is longer in a vertical direction than horizontally. There is no external suture between this episternum and the metanotum.

Abdomen. There are no apical spines on the tergites. The tergites bear each two rows of bristles, the anterior row being more or less incomplete on the posterior segments of the ♂, while the ♀ has some additional bristles on the sixth and seventh tergites. The basal sternite bears a number of small hairs on the side, the other sternites have a postmedian row of bristles and in front of it several small hairs, which are more numerous in the ♀ than in the ♂.

Legs. The mid- and hindcoxae are long and narrow. The hind-femur bears a row of about 8 bristles on the inner side, there being on the outer side in the ♂ 1 or 2 bristles, and in the ♀ a row of about 5, besides 3 or 4 present in both sexes and more dorsal in position. The hindtibia bears on the outside two lateral rows of bristles, one row being placed near the dorsal bristles and the other near the ventral (= anterior) edge, this edge bearing some additional bristles. The first and second midtarsal segments are equal in length, or the first is but a very little longer than the second. The first, second and third hindtarsal segments are rather strongly dilated towards the apex, the fourth segment being more than twice as long as it is broad. The longest apical bristle of the second segment does not quite reach to the apex of the fourth segment. The third pair of lateral bristles of the fifth segment (Pl. IV, fig. 5) are situated at the lateral edge of the segment like the other lateral bristles. There is only one small hair on the ventral surface of this segment.

Modified segments. ♂. The apex of the large eighth sternite is rounded, the segment bearing a postmedian row of bristles and a number of smaller bristles further basad. The clasper (Pl. VII, fig. 3, Cl) is large, quadrangular, the upper apical corner being produced, while the ventral apical corner is completely rounded off. There is a regular row of bristles along the apical edge, the dorsal edge also bearing bristles. The finger (F) is slender, subcylindrical, and slightly acuminate. The manubrium (M) also is slender, widening apically, and forming a small hook. The ventral portion of the ninth sternite (ix. st.) is canoe-shaped, the apex bearing about 10 bristles.—♀. The apical edge of the sixth sternite is straight. The seventh sternite bears a deep narrow sinus, the lobe above this sinus being small and the one below it large. On the eighth tergite there are 6 or more small bristles above the stigma, a row of 4 or 5 bristles on the side, and several small bristles proximally to this row, as well as between this row and the ventral margin. Along the apical edge of the eighth tergite there are about 12 bristles on the outside and more than 12 on the inside. The stylet is long, being subcylindrical.

Length. ♂ 2·1 mm., ♀ 3 mm.

This species was discovered on the Island of St Paul, where it was found on *Eudyptes chrysolophus* Reichenow.

We have 2 ♂♂ and 2 ♀♀ taken off *Endyptula minor* on Bird Island, near Perth, in West Australia (J. Burton Cleland).

These specimens do not agree exactly with Enderlein's figures, and may be a closely allied new species. Some of the figures, however, are

apparently inaccurate in detail, so we have identified our specimens as *longicornis*, in spite of all discrepancies. The figure given by Enderlein of the male genitalia is misleading. This figure also shows 2 antepygidial bristles, while our specimens have only one such bristle, like all members of the genera *Parapsyllus* and *Rhopalopsyllus*. In Enderlein's figure of the ♀, however, only one such bristle is drawn on each side. We may therefore assume that the 2 bristles in the figure of the ♂ are an oversight. In the figure of the ♀ the anal segment bearing the stylet is left out altogether, and the small hairs on the mid- and hindcoxae, on the abdominal sternites and on the eighth tergite are too numerous.

(2) **Parapsyllus simonsi** *Rothsch.* (1904).

(Pl. IV, fig. 1.)

Pulex simonsi Rothschild (1904 *a*, p. 616, t. 9, fig. 30, t. 10, fig. 37, Bolivia, off *Neoctodon simonsi*).
Rhopalopsyllus simonsi Baker (1905 *a*, pp. 130, 144).

Head. The frontal tubercle is situated close to the frontal oral corner. There is a row of bristles beneath the eye along the edge of the genal process. The antennal groove of the ♂ extends close to the crown of the head, there being a distinct internal incrassation from the base of the groove upwards; in the ♀ this incrassation is vestigial. The rostrum reaches to the apex of the forecoxa, the labial palpus consisting of five segments.

Thorax. The mesonotum has a subapical series of thin long spines. The metathoracic epimerum bears a row of 3 (♂) or 4 (♀) bristles running from the stigma downwards.

Abdomen. There are no apical spines on any of the tergites. The basal tergite has a large patch of small hairs on the side. The tergites bear two rows of bristles in both sexes, the anterior row, which is more or less incomplete on all the segments, being represented by only a few bristles on the posterior tergites of the ♂.

Legs. The mid- and hindfemora bear a row of 7 or 8 bristles on the outside and a row of about 12 on the inner side. The dorsal and apical bristles of the hindtibia (Pl. IV, fig. 1) are extremely long and thin in the ♂, the long bristle of the fifth dorsal pair being longer than the tibia. The first midtarsal segment is a little longer than the second. The first hindtarsal segment of the ♂ is nearly as long as the second, third and fourth together. The first, second and third hindtarsal

segments have each 1 or 2 very long thin apical bristles in the ♂ (the tarsi of our single ♀ are broken). The third pair of bristles of the fifth tarsal segment is placed more towards the centre of the segment than is usual, the sole of this segment having a number of small hairs.

Modified segments. ♂. The eighth sternite, which is large, bears on each side close to the ventral apical corner three long bristles, besides a number of other bristles placed on the lateral surface. The clasper is very large, narrowing into a large curved manubrium. The dorsal apical corner of the clasper is somewhat prolonged upwards, while the ventral margin bears a long slender process furnished with three long bristles at the apex. Along the posterior edge of the clasper there is a row of long bristles. The external horizontal portion of the ninth sternite is also large, the lower apical angle being acuminate. This segment bears three patches of bristles.—♀. The seventh sternite is broadly emarginate, there being no lobe above this shallow sinus, while there is a broad lobe beneath it. The sixth sternite also bears a small sinus. The eighth tergite has a few bristles above the stigma, a row of about 6 long ones running from the stigma downwards, and an apical row of about 8, besides some short bristles situated near the longer apical ones. The stylet is cylindrical.

Length. ♂ 2·1 mm., ♀ 4 mm.[1]

We have 2 ♂♂ and 1 ♀ from Challapata, Bolivia, off *Octodontomys* (= *Neoctodon*) *simonsi*, 11th October, 1901; and another ♂ from Potosi, Bolivia, off *Akodon albiventer*, 26th September, 1901; P. O. Simons.

(3) **Parapsyllus cocyti** *Rothsch.* (1904).

(Pl. II, fig. 2; VI, fig. 5.)

Pulex cocyti Rothschild (1904 *a*, p. 617, n. 12, t. 9, fig. 26, t. 10, fig. 31, Chile, off Burrowing Rat).

Rhopalopsyllus cocyti Baker (1905 *a*, pp. 130, 143).

Head. The rostrum reaches to the apex of the forecoxa, the labial palpus consisting of five segments. There are a number of small hairs beneath the eye, one of them being situated at the tip of the genal process. The frontal tubercle is placed near to the frontal oral angle. There is no incrassation from the antennal groove upwards in either sex.

Thorax. The tergites bear each two rows of bristles, the anterior row not extending so far down as the posterior one. The mesonotum,

[1] In this specimen the segments are extended.

moreover, has a row of thin subapical spines (Pl. II, fig. 2); both the meso- and metanotum have some additional short bristles dorsally in front of the rows.

Abdomen. The tergites have two rows of bristles: the anterior row, however, is incomplete, especially in the ♂, being in this sex represented by only a very few bristles on the central and posterior segments. The posterior row contains on the central segments 14 or 16 bristles on the two sides together. The basal sternite has no bristles on the side. The sternites of segments 3 to 6 bear a row of 6 to 8 bristles on the two sides together, there being no additional bristles in front of this row, the sternite of the seventh segment bearing in the ♀ 10 to 12 bristles.

Legs. The posterior edge of the hindcoxa is only slightly rounded. The mid- and hindfemora bear one subapical ventral bristle on the outside and 2 to 4 lateral ones near the base, there being on the inside one row of bristles, containing on the hindfemur about 6 bristles in the ♂ and 9 in the ♀. The tibiae bear one row of lateral bristles. The first midtarsal segment is shorter than the second. The fourth hindtarsal segment is one-third longer than it is broad.

Modified segments. ♂. The clasper (Pl. VI, fig. 5, Cl) is almost square, the upper angle being slightly acuminate, and the lower angle rounded off. There is a row of bristles along the distal and dorsal edges as shown in the figure (Pl. VI, fig. 5). The finger (F) is small, elongate-conical, bearing a row of bristles at the distal edge. The ninth sternite is slightly curved, the obtuse tip being somewhat dilated.—♀. The eighth tergite bears a row of 8 or 9 bristles along the apical and ventral edges, there being between this row and the stigma 6 or 7 more bristles on the side; on the inner surface of the segment there is a dense patch of bristles near the apex. The stylet is cylindrical, being twice as long as it is broad.

Length. ♂ 1·45 mm., ♀ 2·1 mm.

A small series of both sexes from the Coast Hills, Chile, off Burrowing Rat; also from Valparaiso, no host being given; J. A. Wolffsohn.

(4) **Parapsyllus corfidii** *Rothsch.* (1904).

(Pl. VI, fig. 6.)

Pulex corfidii Rothschild (1904 *a*, p. 619, n. 13, t. 9, fig. 27, t. 10, fig. 33, Valparaiso, off *Octodon degus*).

Rhopalopsyllus corfidii Baker (1905 *a*, pp. 130, 144).

Head. The frons is much more strongly rounded than in the other

three species of *Parapsyllus*, the frontal tubercle, moreover, being placed farther away from the frontal oral corner than is the case in the other species. The bristles, too, at the genal edge are more numerous. The rostrum does not reach to the apex of the forecoxa, the labial palpus consisting of only four segments, of which the last is much the longest. The internal incrassation of the skeleton from the antennal groove upwards is vestigial in the ♂, and quite absent from the ♀.

Thorax. The thoracical tergites have each two rows of bristles, the mesonotum bearing an additional row, besides a row of subapical long slender spines. The metathoracic episternum is longest in a vertical direction. The epimerum of the metathorax has two rows of bristles (5 to 7, 4 or 5).

Abdomen. The proximal tergites bear short apical spines, the comb consisting of 15 or 16 spines on the first tergite. The tergites have each two rows of bristles, there being some additional small bristles on the seventh tergite in the ♀. The bristles of the rows are very numerous, there being in the posterior row of the central segments some 30 bristles in the ♀ and about 24 in the ♂. The sternites have a row of about 16 bristles on the two sides together, with additional bristles in front, the basal sternite bearing a row of small bristles on the side with some additional hairs before it.

Legs. The bristles situated anteriorly on the outer surface of the broad and rounded hindcoxa are very numerous. All the femora and tibiae bear also very numerous bristles on the outside. These bristles are more or less arranged in rows, being more numerous in the ♂ than in the ♀, the tarsi also bearing numerous bristles on the outer surface. There is a row of bristles on the inner side of the mid- and hindcoxae. The first midtarsal segment is a little longer than the second. The fourth hindtarsal segment is nearly twice as long as it is broad.

Modified segments. ♂. The clasper is triangular, with the ventral margin strongly rounded (Pl. VI, fig. 6). The manubrium (M) is very broad, becoming gradually narrower and curving upwards apically. There are 4 long and several short bristles at the ventral and distal edges of the clasper (Cl). The finger (F) is small and conical, being slightly curved and bearing a number of small bristles. The ventral portion of the ninth sternite (ix. st.) is almost straight, being slightly rounded ventrally and bearing a number of bristles on the distal half.—♀. The apical edge of the seventh sternite slopes upwards. The eighth tergite bears two rows of small bristles above the stigma. There is a row of about 10 bristles running from the stigma downwards and

proximally to this row another composed of smaller bristles. Along the apical edge of the eighth tergite there is a row of about a dozen bristles on the outside, the inside bearing two rows of smaller but rather stout bristles.

Length. ♂ 1·4 mm., ♀ 2 mm.

1 ♂ and 3 ♀ ♀ from Valparaiso, Chile, off *Octodon degus* and *Abrocoma bennettii*, collected by J. A. Wolffsohn.

7. *Genus:* **Coptopsylla** *gen. nov.*

Head. Frons truncate (Pl. II, fig. 4); no distinct tubercle above the truncate part. Antennal groove open, the genal process being very short; no distinct internal incrassation from the base of the groove to the vertex (♀). Club of antenna long, segmented all round as in *Parapsyllus*. Labial palpus very long, consisting of 5 segments. No bristles beneath the eye at the edge of the genal process.

Thorax. One row of bristles on the tergites; the mesonotum bearing some long thin spines before the apex. Epimerum of mesothorax nearly horizontal, covering the stigma. Sternum of metathorax long in a dorso-ventral direction.

Abdomen. Tergites with one row of bristles, except the first, which bears two; seventh tergite with a long and a short bristle on a tubercle placed at the apical edge, the latter being excised where the tubercle is placed; the edge between the tubercles of the two sides produced backwards. There are two receptacula seminis as in *Hystrichopsylla* and *Macropsylla*.

Legs. Internal rod-like incrassation of midcoxa forked below middle. Hindcoxa without comb, excised posteriorly before apex, the angle distinct. First fore- and midtarsal segment shorter than second. Fifth tarsal segment with 5 lateral bristles.

Modified segments. ♀. Eighth abdominal tergite bearing some hairs above the stigma. Stylet with an apical bristle and a short one before apex situated in a notch. The ♂ not known to us.

Type of genus: *Pulex lamellifer* Wagner (1895). The genus contains only one species. It is nearly related to *Parapsyllus*, but can easily be recognised by the truncate frons, the 5 lateral bristles on the fifth tarsal segment, and the double receptaculum seminis.

(1) **Coptopsylla lamellifer** *Wagn.* (1895).

(Pl. II, fig. 4.)

Pulex lamellifer Wagner (1895, p. 504, fig. 1, ♂, Transcaspia, from nest of a rodent); Wagner (1898, p. 576); Baker (1904, p. 437).

The rostrum of this insect reaches beyond the middle of the forefemur.

Bolschoj Balchan, Transcaspia, in a rodent's nest found in the ground in May. Both sexes were obtained.

We have one ♀ of this species received from Dr J. Wagner.

8. *Genus:* **Goniopsyllus** *Baker* (1905).

Goniopsyllus Baker (1905 *a*, pp. 128, 140, type of name: *Pulex kerguelensis* Tasch.).

Head. Frons without tubercle but obtusely angulate. Eye placed very low down. A row of bristles from upper oral corner towards base of antenna and several more bristles further back. Antennal groove open behind, extended to vertex in ♂. Club of antenna long, segmented all round, being similar to the club of *Ceratophyllus*. A few small hairs above the antennal groove. Labial palpus consisting of five segments.

Thorax. Pronotum with two rows of bristles and some additional hairs before these rows. Meso- and metanotum densely hairy, the hairs being thin and short, except those of the postmedian row. No subapical spines on mesonotum. Epimerum of mesothorax covering the stigma. Episternum of metathorax small.

Abdomen. Densely hairy. Stigmata lanceolate. Proximal tergites with some small apical teeth; seventh tergite with 2 long apical bristles on each side, placed on a tubercle at the edge. Sternites also densely hairy, except basal one. Sensory plate (pygidium) strongly convex, projecting backwards.

Legs. Internal rod-like incrassation of midcoxa dividing about centre. No comb on hindcoxa. First midtarsal segment longer than second; fifth tarsal segment narrow, the bristles small, 5 on each side and 3 or 4 ventrally near the apex (Pl. IV, fig. 2).

Modified segments. ♂. Clasper with one movable process (the finger), which is long; ninth sternite boomerang-shaped, the internal, vertical arm pointed, the point being directed frontad, the horizontal arm spinose at apex, suggesting this sternite of *Hystrichopsylla*.—

♀. Seventh sternite sinuate. Anal segment very long, as it is also in the ♂. Stylet cylindrical, about twice as long as it is broad.

Most nearly related to *Hystrichopsylla* Tasch. (1880) and *Macropsylla* Rothsch. (1905). The female possibly has two receptacula seminis as in the genera mentioned. The two ♀ specimens, however, contained in the British Museum are not well enough preserved for deciding the question.

The genus so far contains only one species.

(1) **Goniopsyllus kerguelensis** *Tasch.* (1880).

(Pl. IV, fig. 2; VII, fig. 11.)

Pulex spec. Eaton (1875, p. 2, "A Pulex is parasitic on *Haladroma*, and one (possibly the same) on *Diomedea fuliginosa*").

Pulex kerguelensis Taschenberg (1880 *a*, p. 67, n. 7, t. 2, fig. 12, ♀, Kerguelen); *id.* (1880 *a*, p. 123, host: *Pelecanoides urinatrix*); *id.* (1880 *b*, p. 169); Baker (1895, p. 65); Rothschild (1895, p. 66, Antipodes).

Pulex verguelensis Wagner (1898, p. 576).

The abdominal tergites are emarginate dorsally.

There are in the British Museum one ♂ and two ♀ ♀ of the original four specimens obtained by the Rev. A. E. Eaton off *Pelecanoides urinatrix* on Kerguelen Island during the Transit-of-Venus Expedition[1]. The flea off *Diomedea* mentioned by Eaton, *l.c.*, is apparently not contained in the British Museum's collection.

We have one ♂ from Antipodes Island, off *Platycercus unicolor*, collected by Mr M. Dannefaerd.

9. *Genus:* **Lycopsylla** *Rothsch.* (1904).

Lycopsylla Rothschild (1904 *a*, p. 602, name-type: *L. novus*); Baker (1905, p. 127, a new family proposed for its reception).

Head. Frons with a tooth-like tubercle about half-way between the oral angle and the occiput. The lower oral angle produced downwards into a slightly curved triangular lobe. Genal process pointed, closing the antennal groove. An internal incrassation from the base of the antennal groove upwards. Club of antenna similar to that of *Parapsyllus*. Labial palpus consisting of four segments, segmentation well marked all round, tip of last segment symmetrical, with 3 hairs on each side, as in *Rhopalopsyllus* and *Goniopsyllus*.

[1] An account of this Expedition is published in *Philos. Trans. Roy. Soc.*, vol. CLXVIII. (1879) (extra volume), the four examples of this flea being recorded on p. 118.

Thorax. Mesonotum with a row of thin subapical spines.

Abdomen. One row of bristles on the tergites, there being an anterior additional row on the first tergite. Seventh tergite without antepygidial bristles in both sexes. Sensory plate not convex in side-view. ♀ without stylet.

Legs. Internal rod of midcoxa forking about centre. Hindcoxa without comb of short spines on the inside. Bristles of tibiae and tarsi stout. First midtarsal segment shorter than the second. Fifth tarsal segment long, with 6 (rarely 5) lateral bristles, besides the subapical hair. Claw long and slender, non-dentate, with the basal projection vestigial.

Modified segments. Of a similar type as in *Rhopalopsyllus* and *Parapsyllus*. The bristles on the anal segment of the ♀ very numerous.

Only one species is known of this Australian genus.

(1) **Lycopsylla novus** *Rothsch.* (1904).

Lycopsylla novus Rothschild (1904 *a*, p. 602, n. 1, t. 7, figs. 1—4); Baker (1905 *a*, p. 139).

We have both sexes from Hampden, New South Wales, off *Phascolomys mitchelli*, collected December 17, 1899, by Dr J. P. Hill.

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EXPLANATION OF PLATES.

PLATE I.

Fig. 1. Loemopsylla cheopis ♂.

PLATE II.

Fig. 1. Head and thorax of *Pariodontis riggenbachi* ♂.
pron = pronotum; meson = mesonotum; metan = metanotum; sti = stigma; st = sternum; est = episternum; em = epimerum.
Fig. 2. Lateral view of mesothorax of *Parapsyllus cocyti*.
Fig. 3. Head and prothorax of *Rhopalopsyllus cleophontis*.
Fig. 4. Head of *Coptopsylla lamellifer* ♀.
Fig. 5. Head of *Loemopsylla cheplrenis*.
Fig. 6. Hindfemur of *Loemopsylla erilli* ♂.
Fig. 7. The same of *Loemopsylla cheplrenis* ♂.
Fig. 8. Apex of labial palpus of *Loemopsylla cheopis*.
Fig. 9. The same of *Rhopalopsyllus cleophontis*.
Fig. 10. Apex of the rostrum (= the two labial palpi) of *Loemopsylla divergens*.
Fig. 11. The same of *Loemopsylla creusae*.
Fig. 12. Head of *Parapsyllus longicornis* ♂ (drawn from a mounted specimen).
Fig. 13. Head and thorax of *Moeopsylla sjoestedti*.
Fig. 14. Hindcoxa of *Loemopsylla regis* ♂.
Fig. 15. The same of *Loemopsylla erilli* ♂.
Fig. 16. The same of *Locmopsylla isidis* ♂.
Fig. 17. Frontal view of head of *Pariodontis riggenbachi*.

PLATE III.

Fig. 1. First hindtarsal segment of *Loemopsylla gerbilli* ♀.
Fig. 2. The same of *Loemopsylla mycerini* ♀.
Fig. 3. Apex of the hindtibia and the first and second hindtarsal segments of *Loemopsylla nesiotes* ♀.
Fig. 4. Midtarsus and apex of the midtibia of *Loemopsylla pallidus*.
Fig. 5. The first to fourth midtarsal segments of *Loemopsylla chersinus* ♂.
Fig. 6. The same of *Loemopsylla nubicus* ♂.
Fig. 7. Hindtarsus of *Loemopsylla cleopatrae* ♀, 2 to 5 segments.
Fig. 8. Midtarsus and apex of the midtibia of *Loemopsylla somalicus* ♂.
Fig. 9. Hindtibia and apex of the hindfemur of *Loemopsylla longispinus* ♀, the longest apical bristles being broken at the tip.
Fig. 10. Fifth hindtarsal segment of *Rhopalopsyllus cleophontis* ♀, ventral aspect.
Fig. 11. First and second midtarsal segments of *Rhopalopsyllus australis* ♂.
Fig. 12. The same of *Rhopalopsyllus lugubris* ♂.
Fig. 13. The same of *Rhopalopsyllus cacicus* ♂.

PLATE IV.

Fig. 1. Hindtibia of *Parapsyllus simonsi* ♂.
Fig. 2. Fifth midtarsal segment of *Goniopsyllus kerguelensis* ♂.
Fig. 3. Fifth foretarsal segment of *Rhopalopsyllus cavicola* ♀.
Fig. 4. Fifth hindtarsal segment of *Rhopalopsyllus bolulsi* ♀.
Fig. 5. The same of *Parapsyllus longicornis* ♀.

Fig. 6. Genitalia of *Loemopsylla nubicus* ♂.
Cl = clasper; Pen. = penis; Pen.-Pl. = penis-plate; P^1 and P^2 processes of the clasper; IX. st. = ninth sternite; IX. t. = ninth tergite; X. t. = tenth tergite; X. st. = tenth sternite; M = manubrium.
Fig. 7. The same of *Loemopsylla cleopatrae* ♂.
Fig. 8. The same of *Loemopsylla cheopis* ♂.
Fig. 9. The same of *Loemopsylla pallidus* ♂.
Fig. 10. The same of *Loemopsylla regis* ♂.
Fig. 11. The same of *Loemopsylla isidis* ♂.
Fig. 12. The same of *Loemopsylla creusae* ♂.

PLATE V.

Fig. 1. Genitalia of *Loemopsylla scopulifer* ♂.
Fig. 2. The same of *Loemopsylla crilli* ♂.
Fig. 3. The same of *Loemopsylla niloticus* ♂.
Fig. 4. The same of *Loemopsylla tortus* ♂.
Fig. 5. The same of *Loemopsylla chersinus* ♂.
Fig. 6. The same of *Loemopsylla ramesis* ♂.
Fig. 7. Eighth abdominal segment of *Loemopsylla regis* ♀.
VIII. t. = eighth tergite; VIII. st. = eighth sternite.
Fig. 8. The same of *Loemopsylla pallidus* ♀.
sti. = stigma.
Fig. 9. The same of *Loemopsylla scopulifer* ♀.

PLATE VI.

Fig. 1. Terminal segments of the abdomen of *Loemopsylla cheopis* ♀.
Fig. 2. The same of *Loemopsylla divergens* ♀.
Fig. 3. The same of *Loemopsylla isidis* ♀.
Fig. 4. The same of *Loemopsylla nesiotes* ♀.
Fig. 5. Genitalia of *Parapsyllus cocyti* ♂.
Fig. 6. The same of *Parapsyllus corfidii* ♂.
Fig. 7. The same of *Rhopalopsyllus cleophontis* ♂.
Fig. 8. Ninth abdominal sternite of *Rhopalopsyllus cacicus* ♂.
Fig. 9. The same of *Rhopalopsyllus lugubris* ♂.
Fig. 10. The same of *Rhopalopsyllus australis* ♂ from Minas Geraës.
Fig. 11. The same of *Rhopalopsyllus australis* ♂, from Mexico.

PLATE VII.

Fig. 1. Genitalia of *Loemopsylla gerbilli* ♂.
Fig. 2. The same of *Loemopsylla mycerini* ♂.
Fig. 3. The same of *Parapsyllus longicornis* ♂.
Fig. 4. Eighth abdominal tergite and seventh to ninth sternites of *Loemopsylla eridos* ♀.
Fig. 5. Eighth abdominal tergite of *Loemopsylla crilli* ♀.
Fig. 6. Ninth abdominal sternite of *Rhopalopsyllus bernhardi* ♂.
Fig. 7. Genitalia of *Rhopalopsyllus bohlsi* ♂.
Fig. 8. The same of *Rhopalopsyllus klagesi* ♂.
Fig. 9. Eighth abdominal tergite of *Rhopalopsyllus klagesi* ♀.
Fig. 10. The same of *Rhopalopsyllus plateusis* ♀.
Fig. 11. Ninth abdominal sternite of *Goniopsyllus kerguelensis* ♂.

K. Jordan del.

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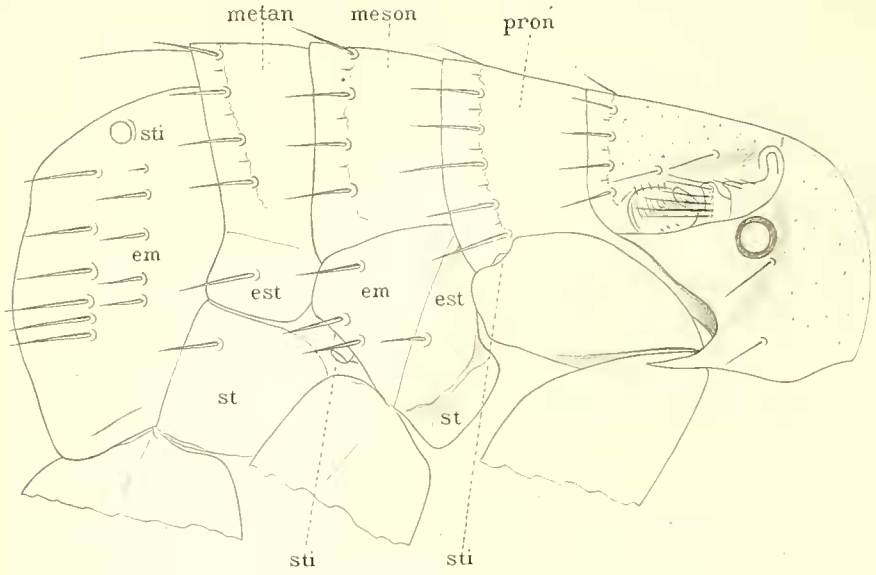
Loemopsylla cheopis ♂.



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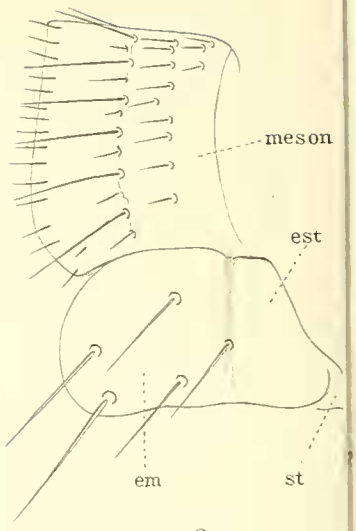

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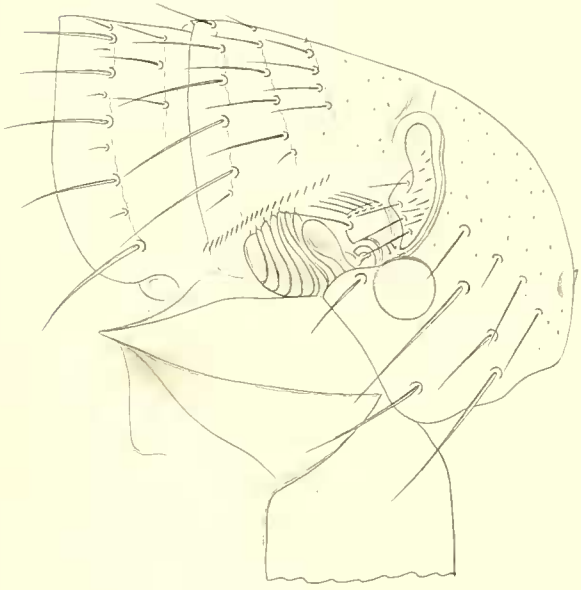
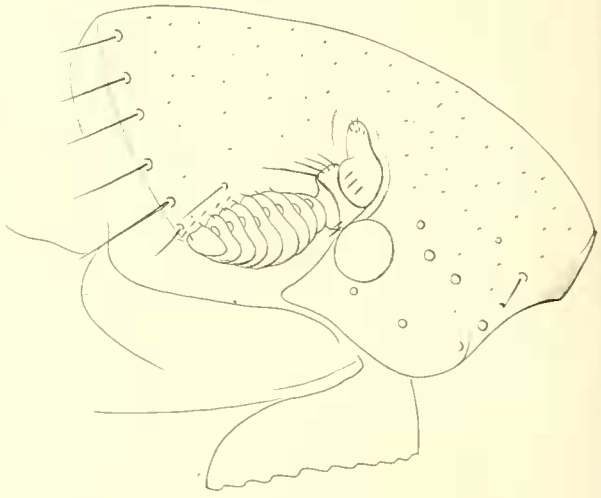


3.



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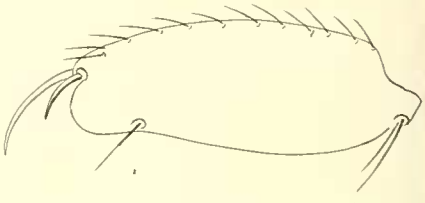

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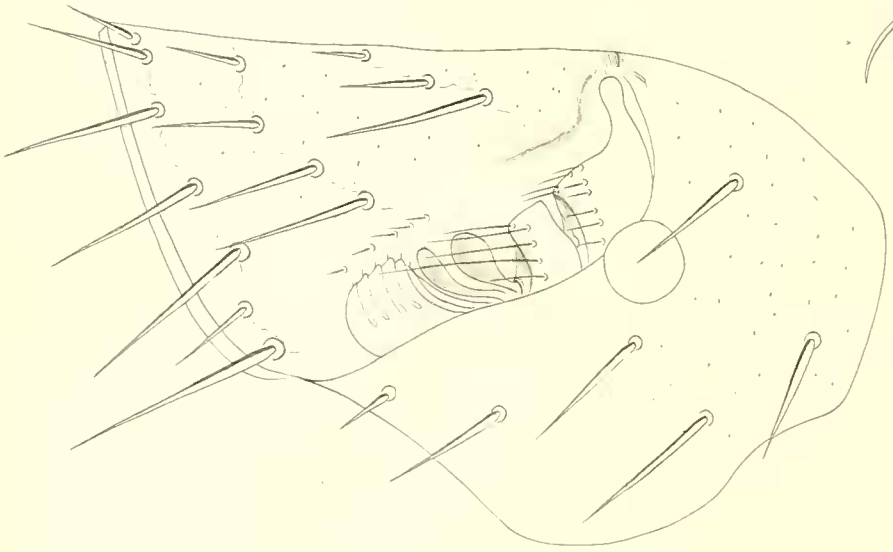

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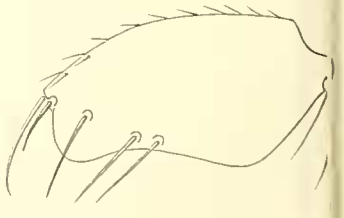

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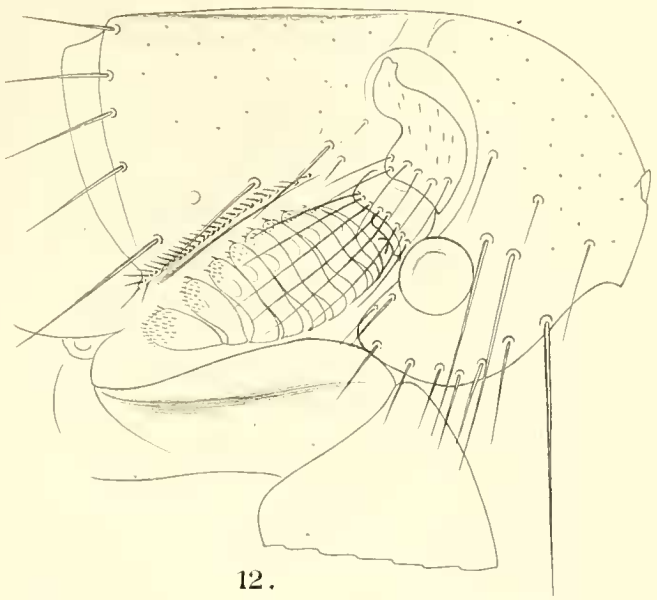

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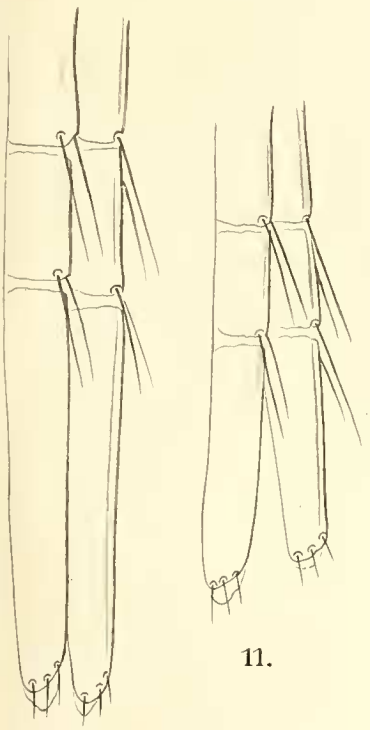

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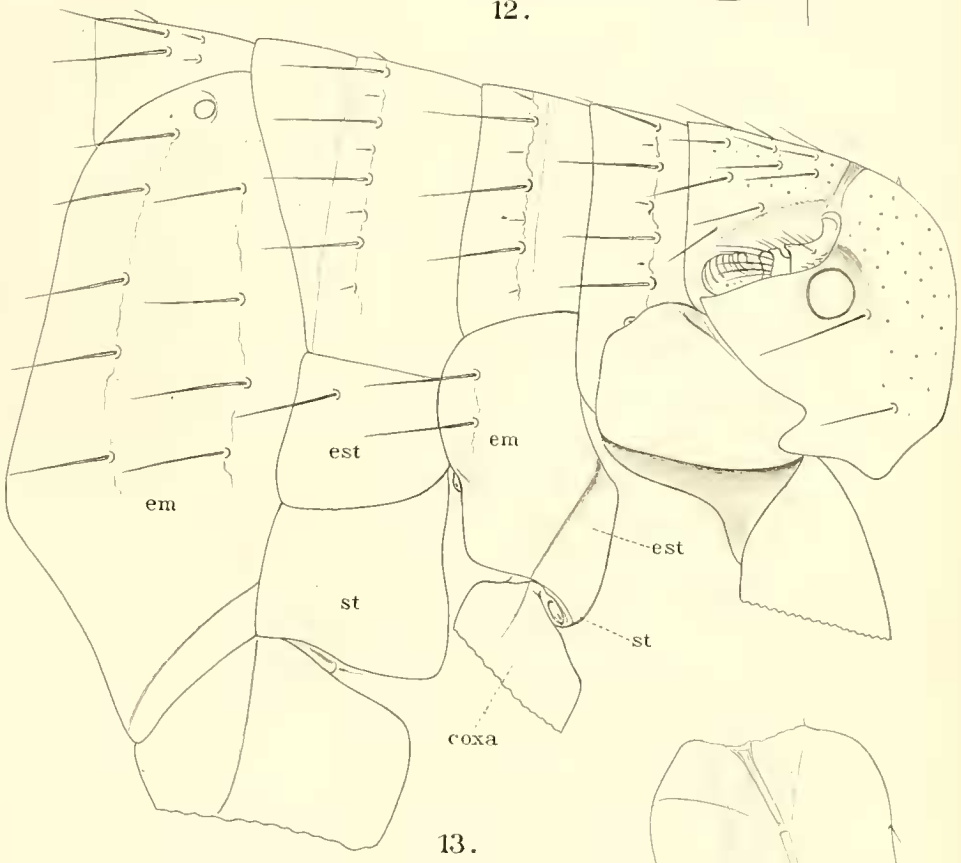

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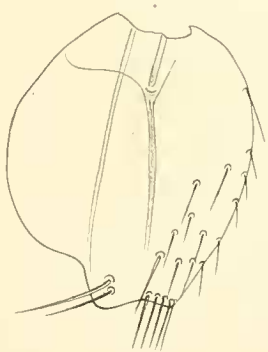

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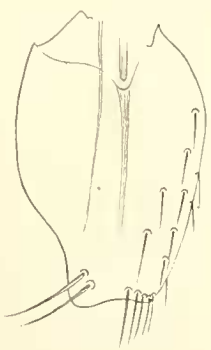

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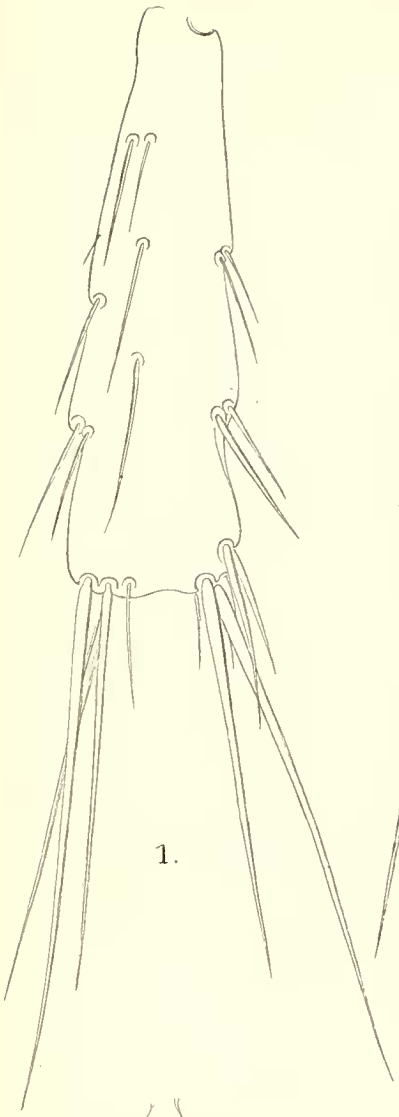
Lith.Anst.v.K.Wesser,Jena.



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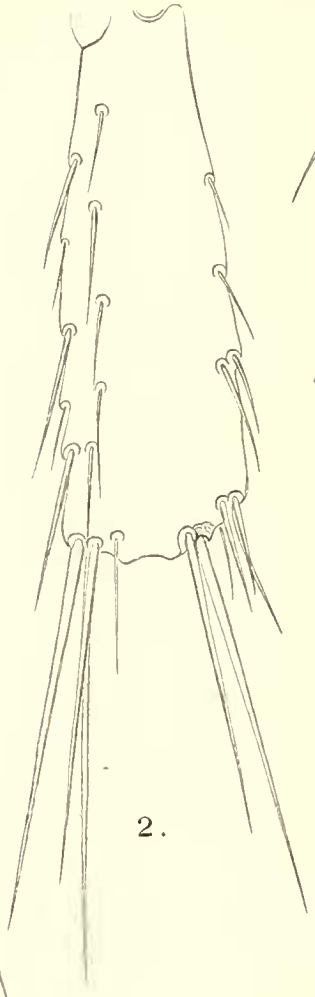

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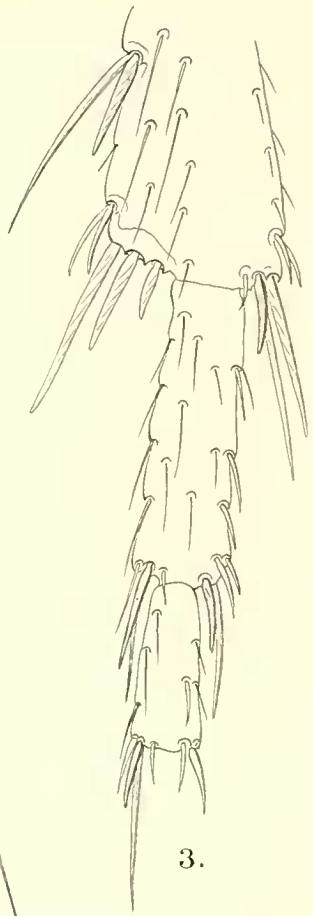

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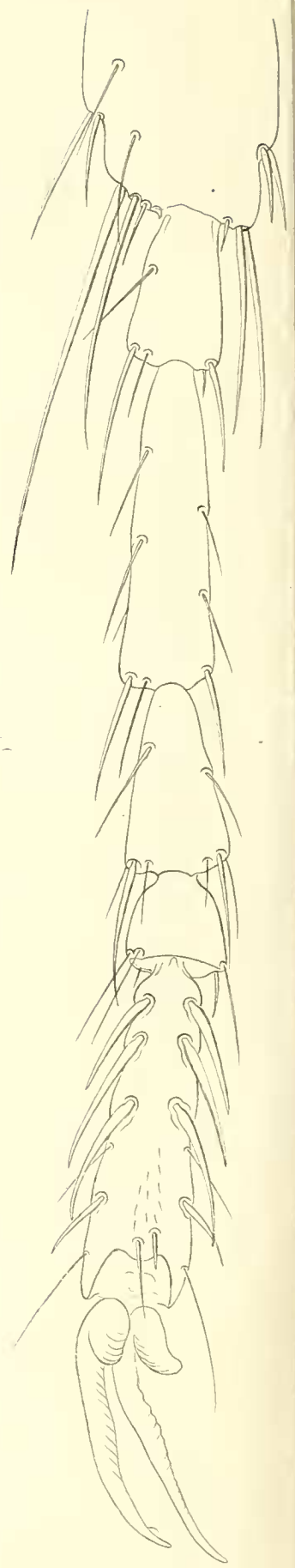

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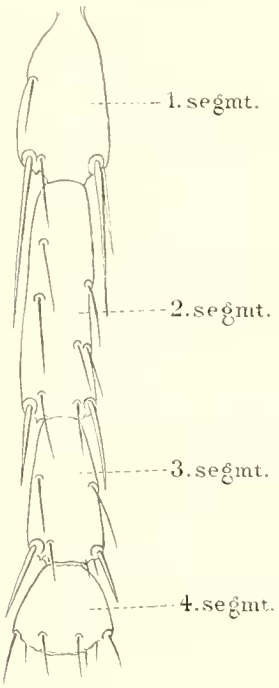

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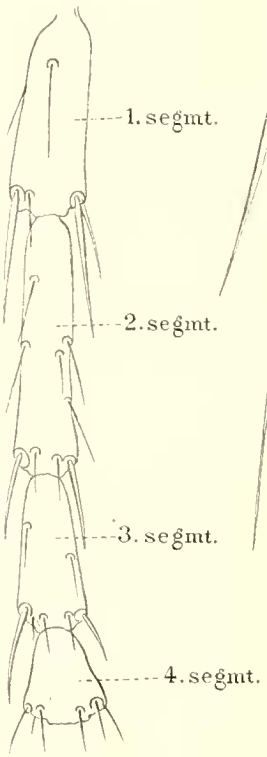

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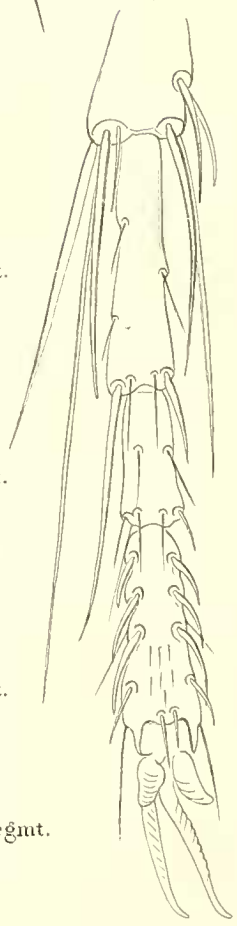

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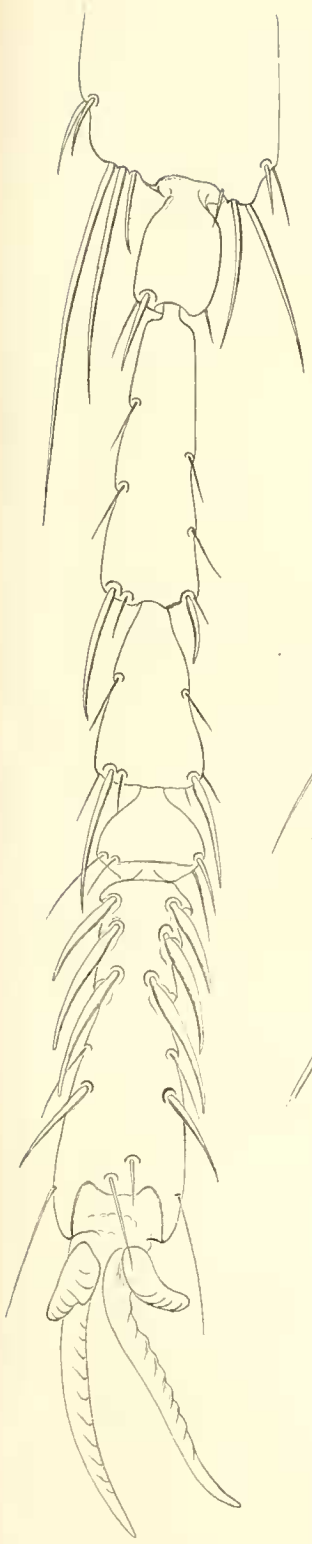

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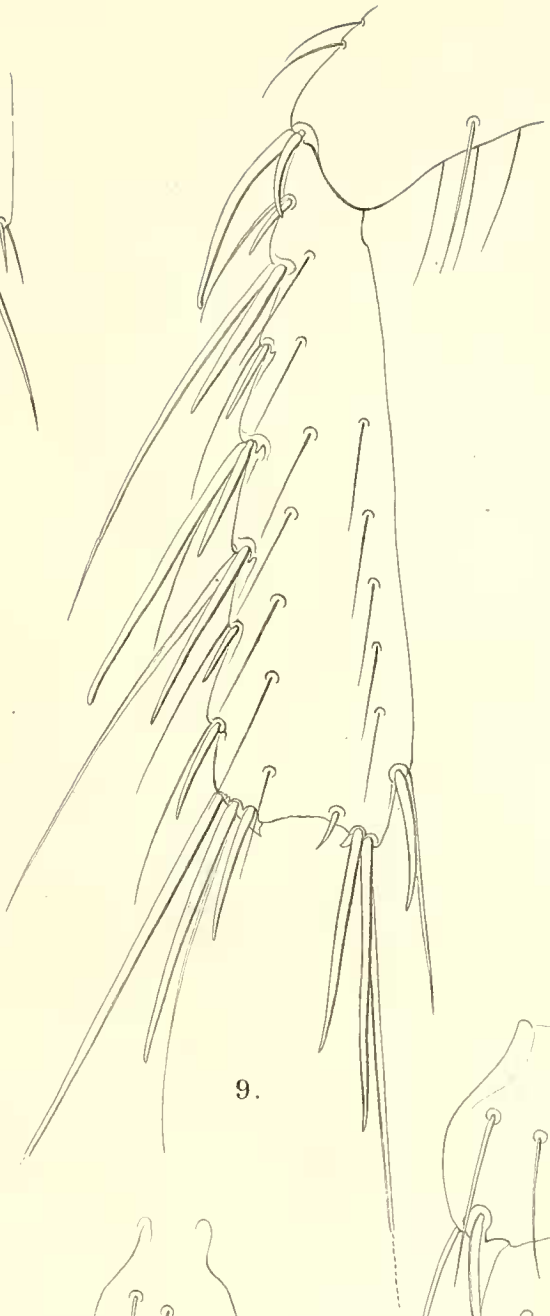

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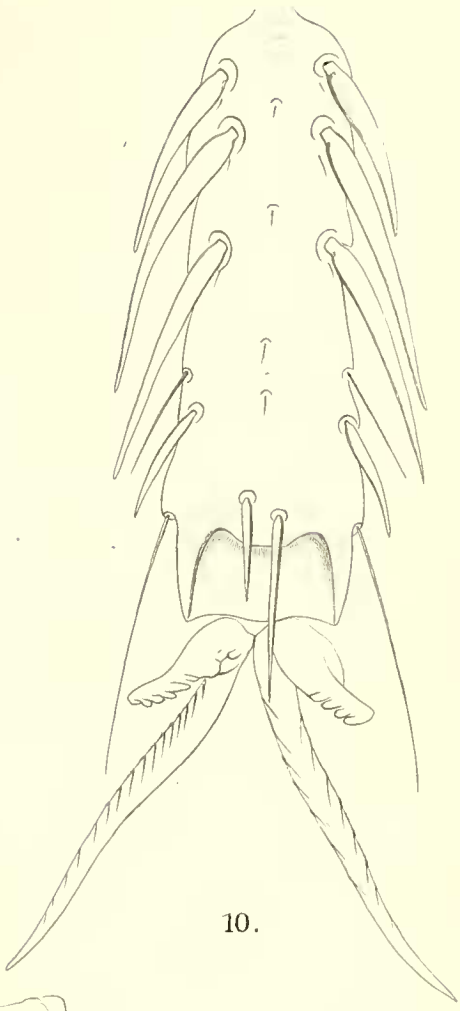

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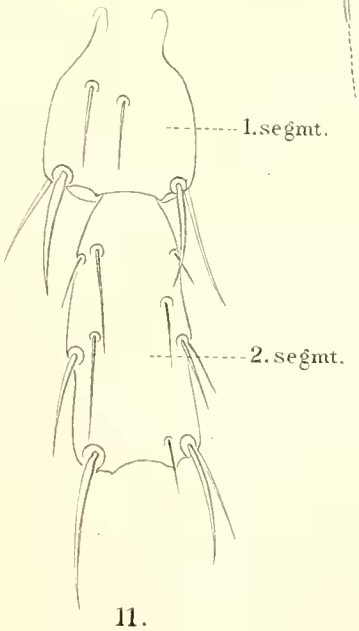

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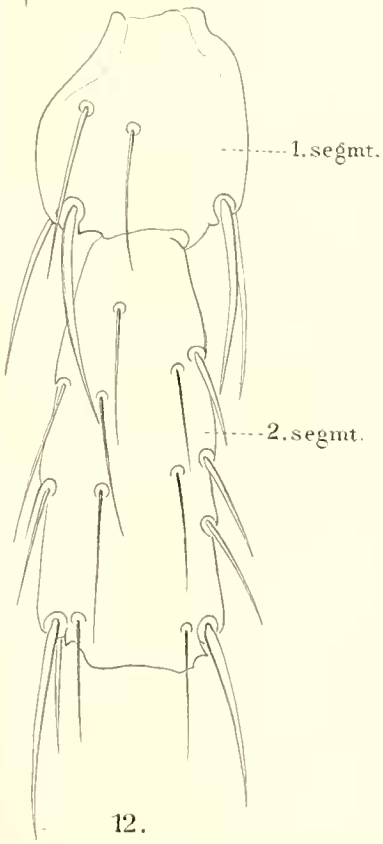

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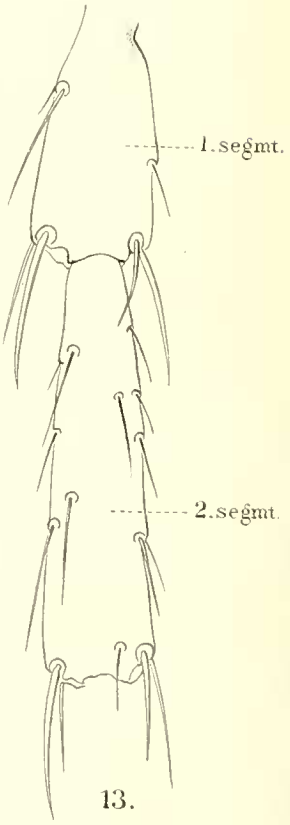

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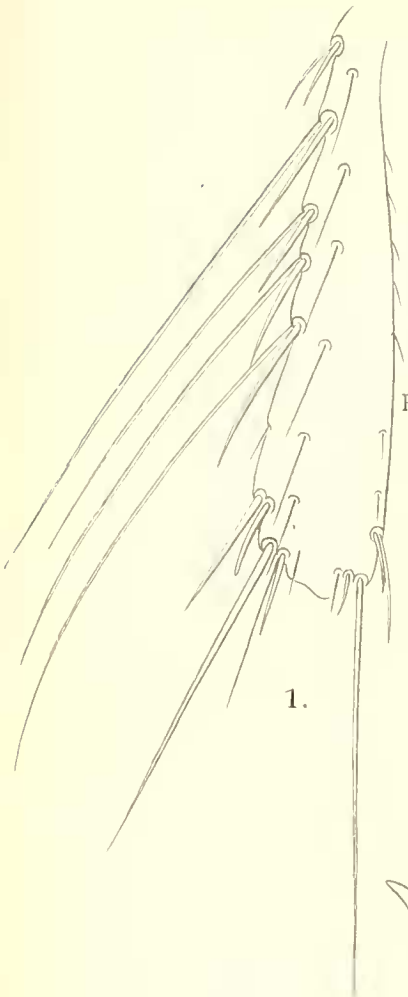
Lith. Anst. v. K. Wesser, Jena.



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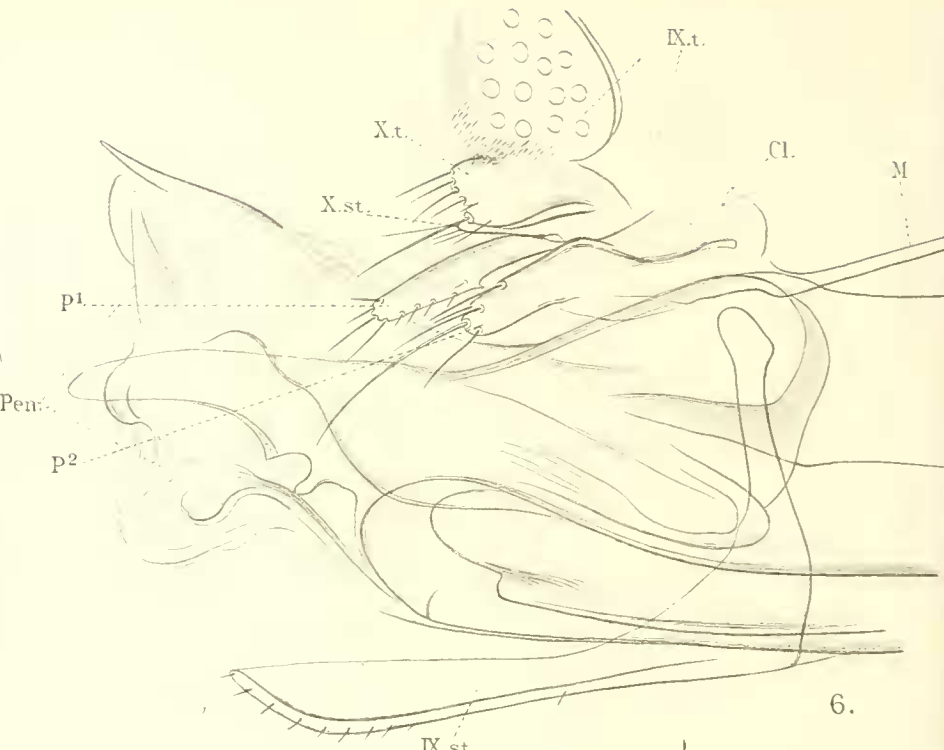

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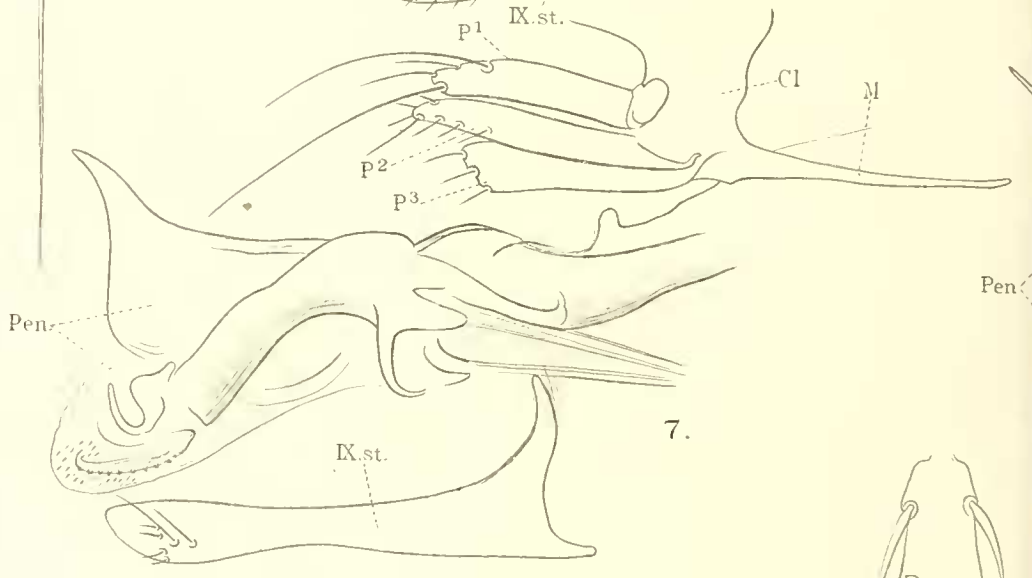

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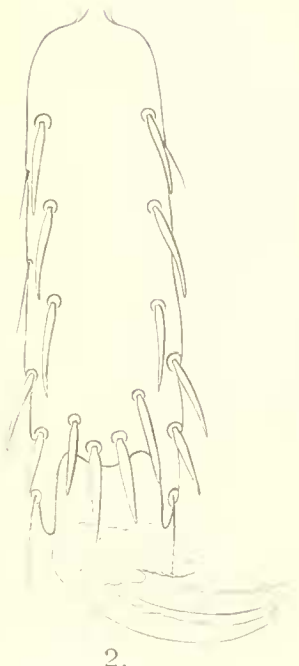

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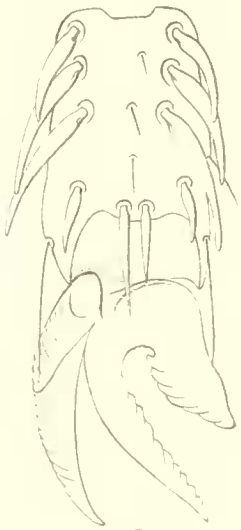

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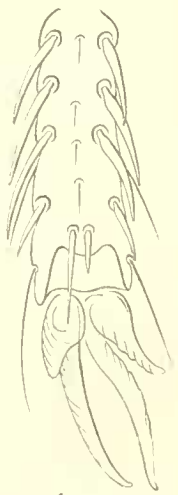

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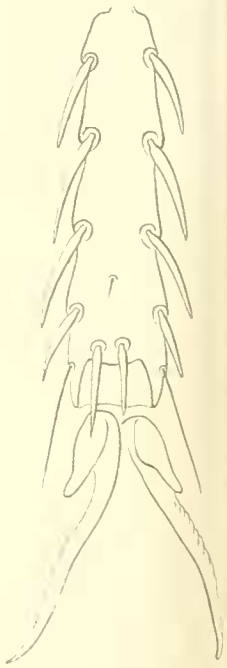

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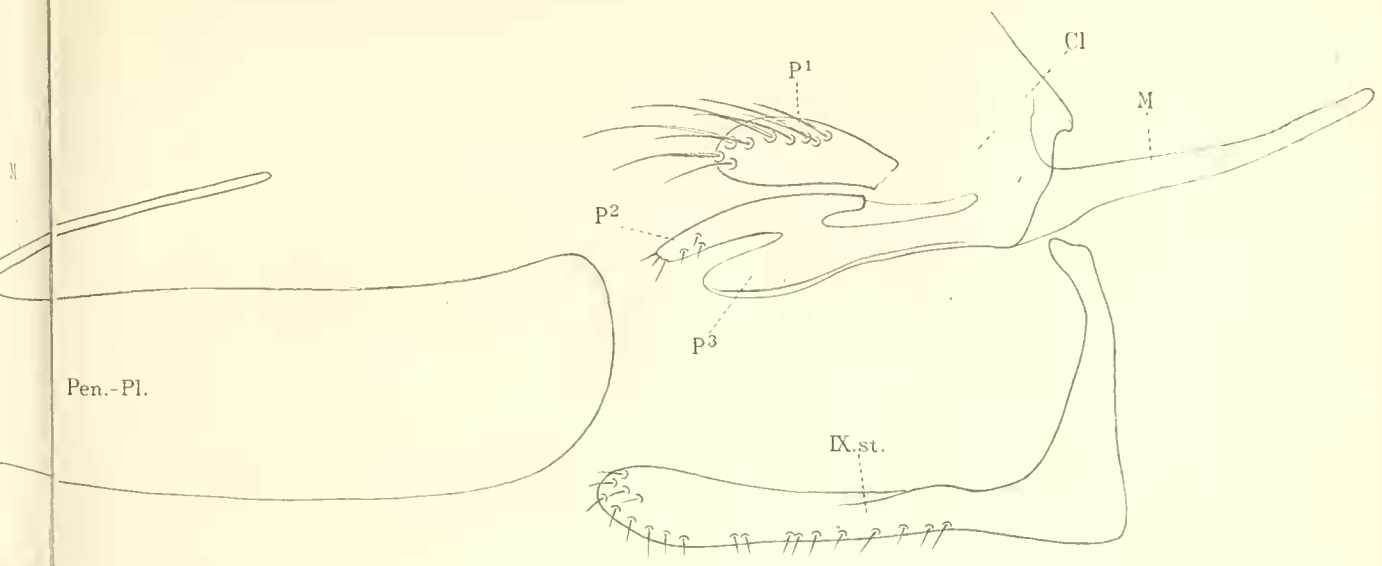

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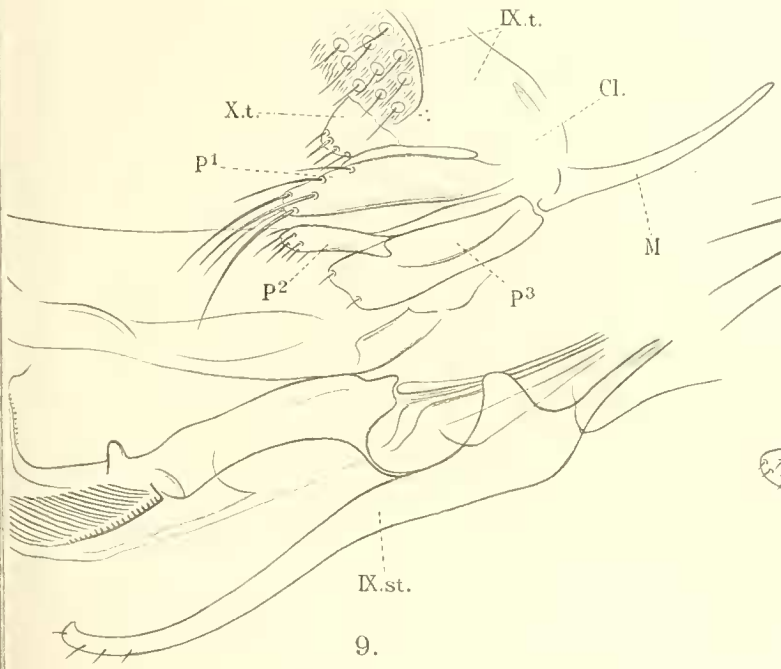

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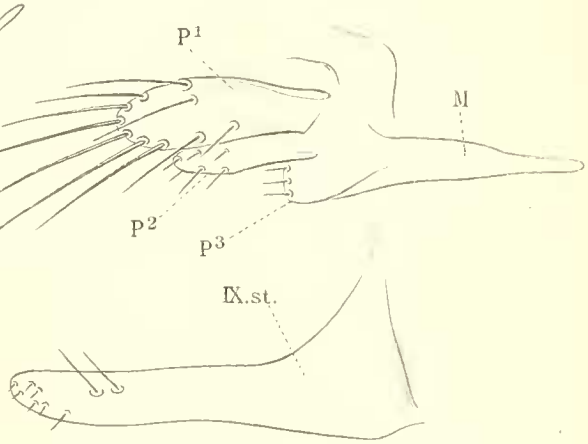

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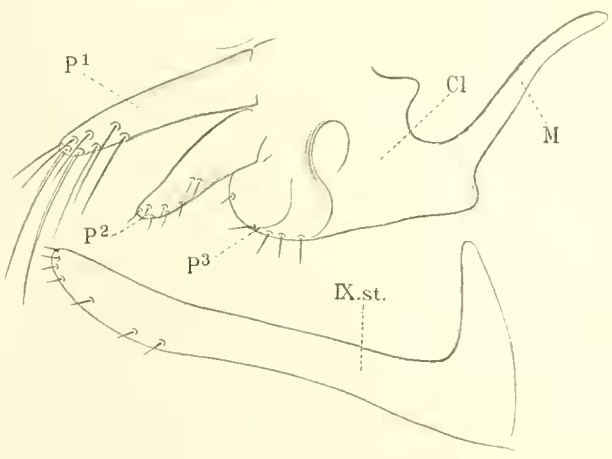

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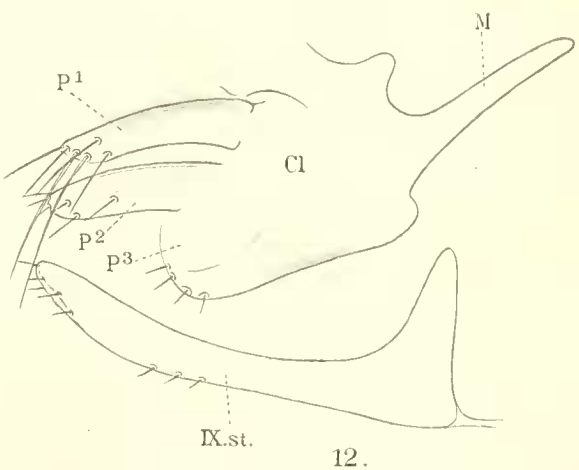

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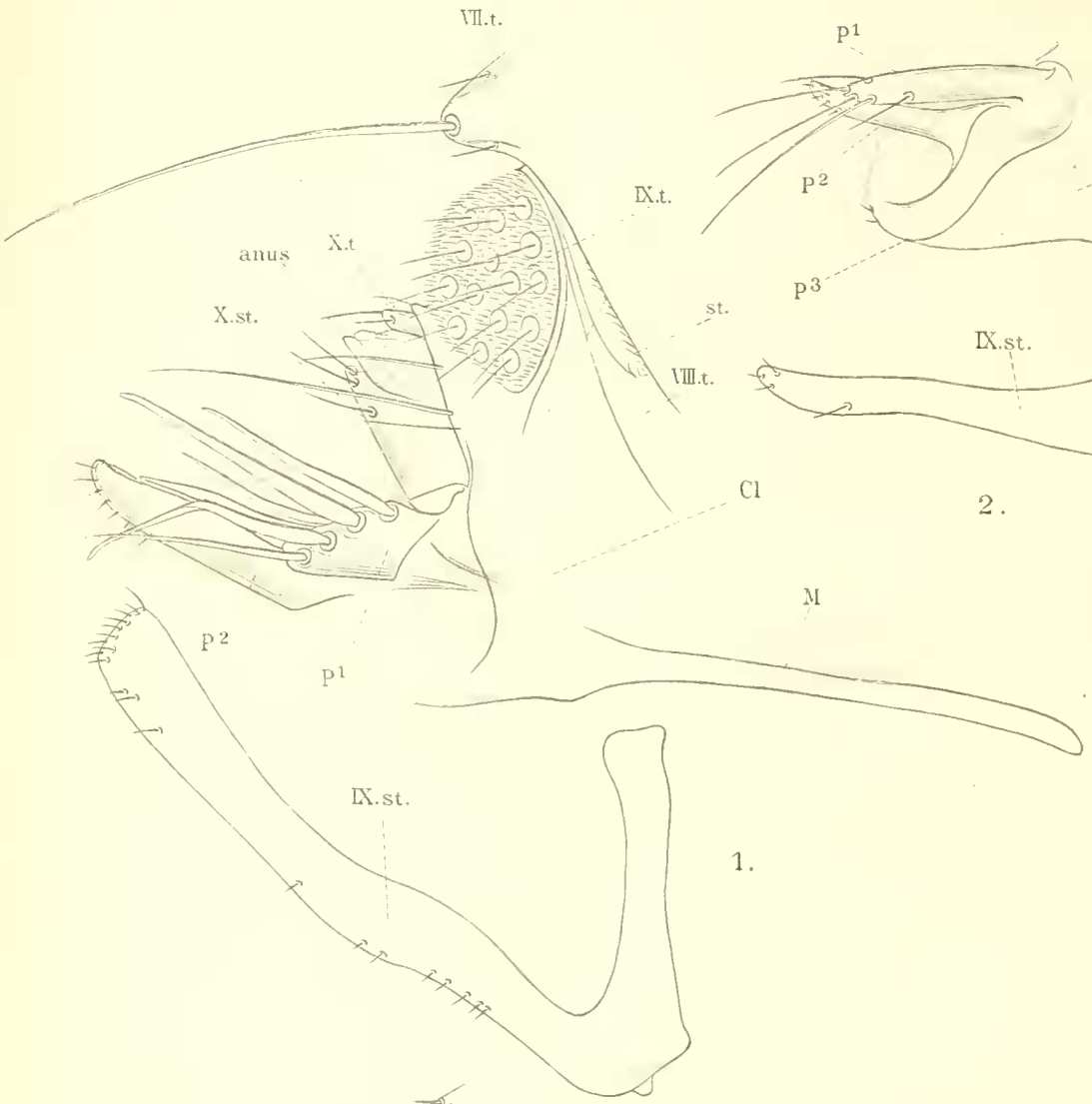
Lith.Anst.v.K.Wesser,Jena.



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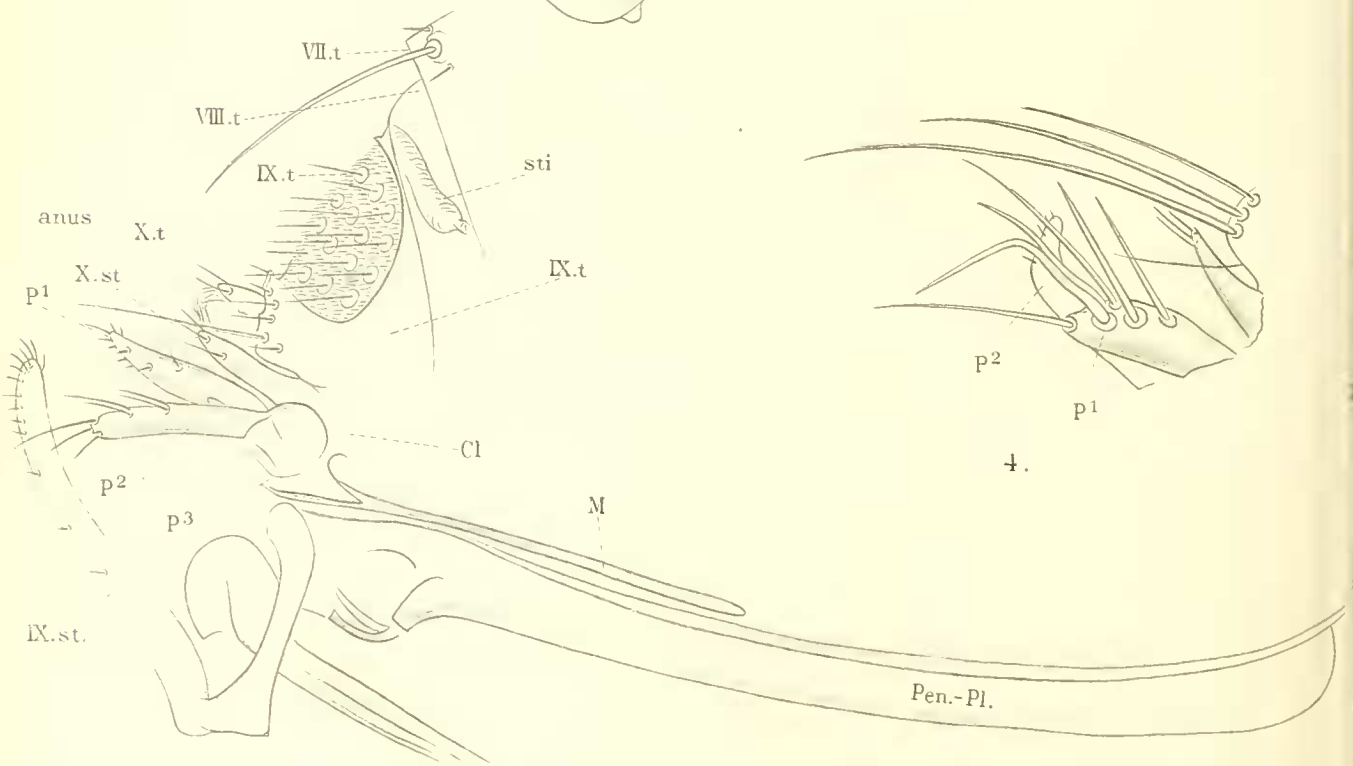

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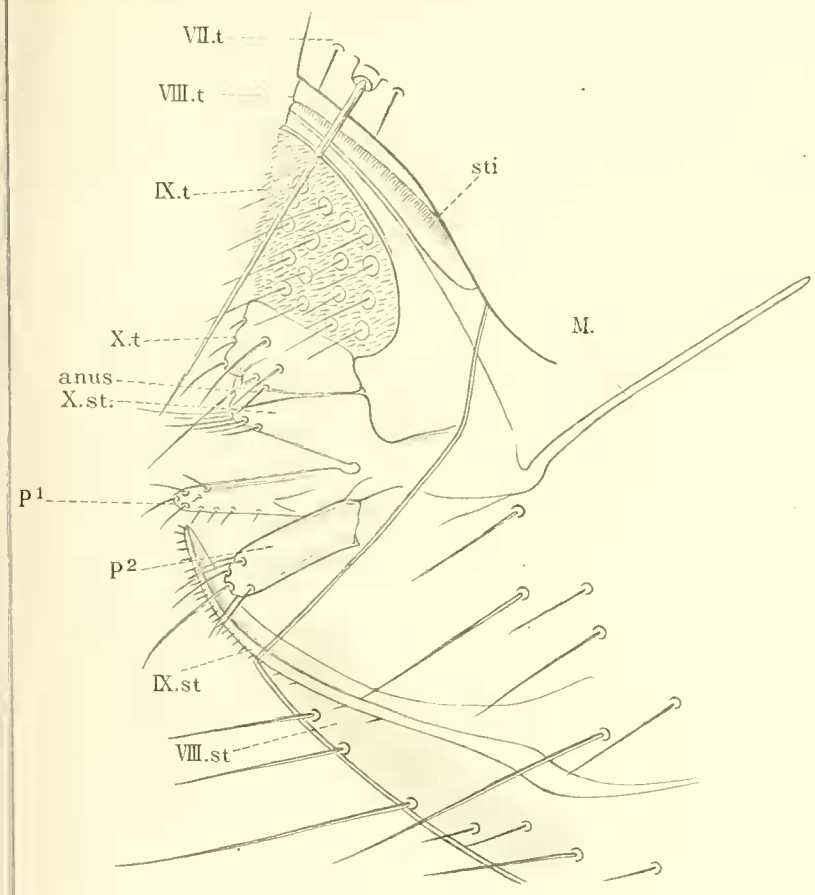

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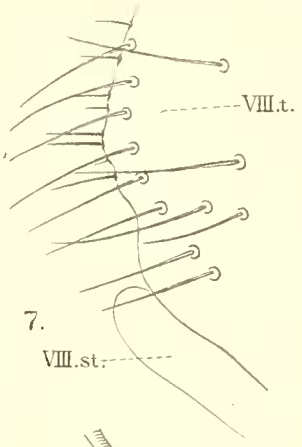

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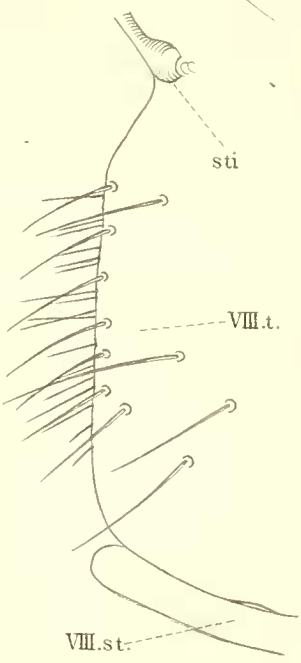

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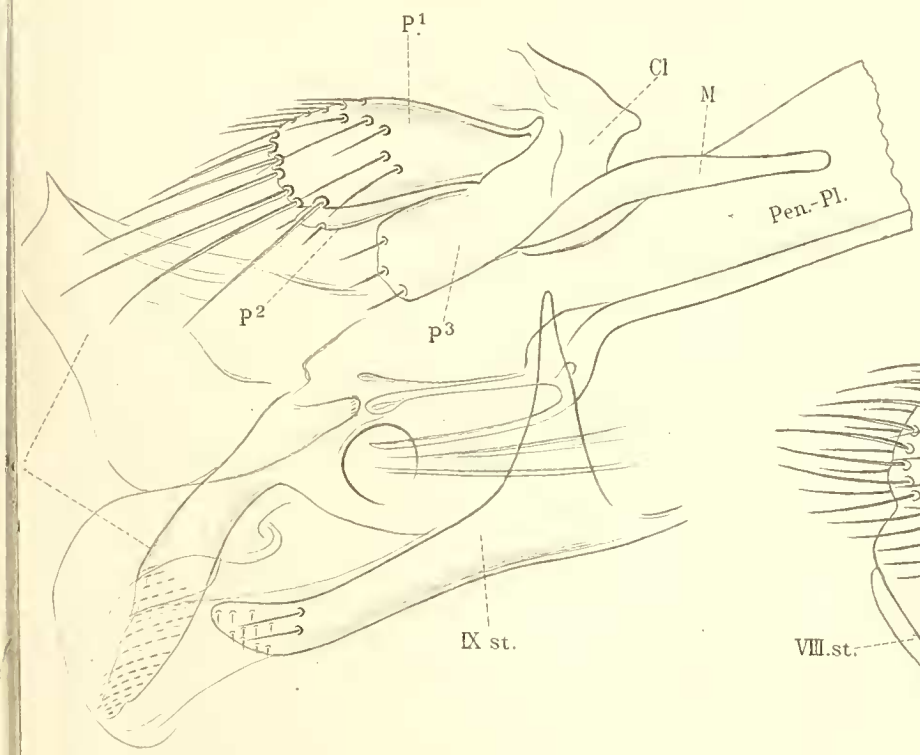

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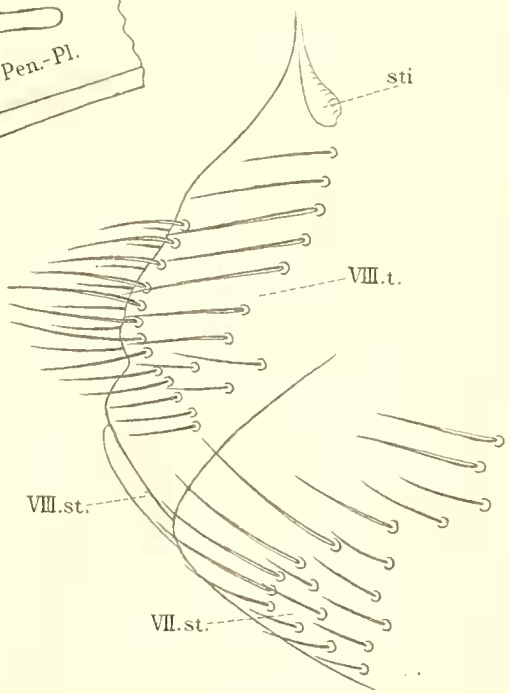

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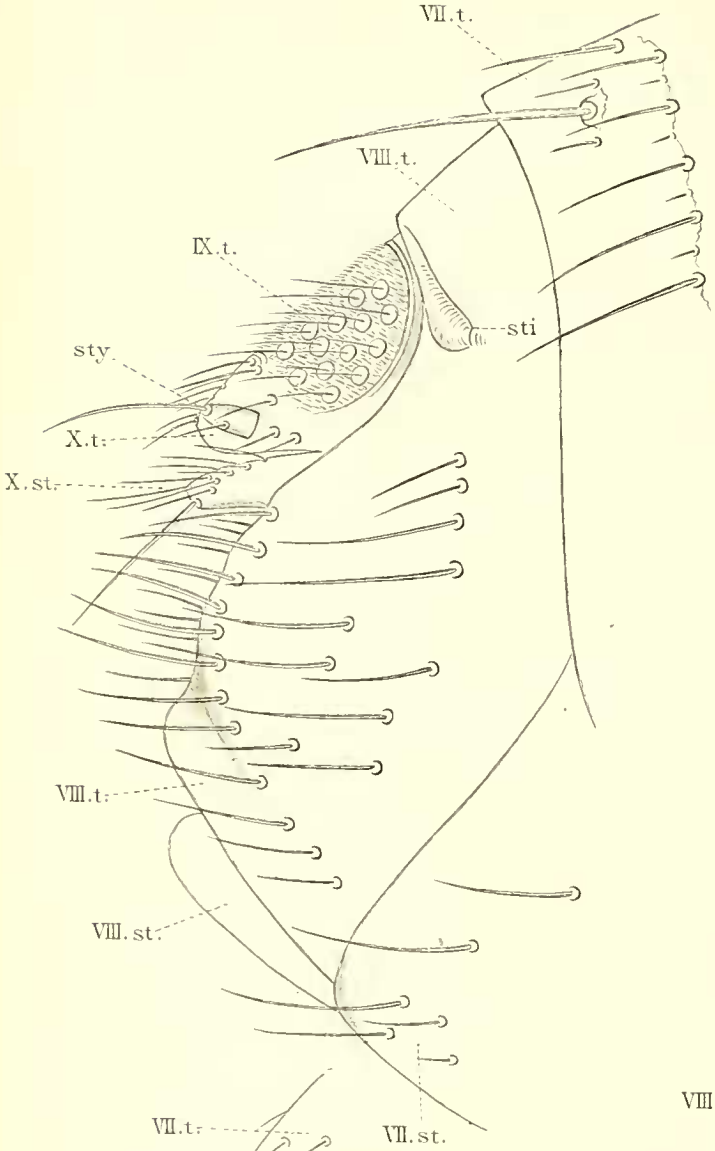
Lith.Anst.v.K.Wesser,Jena.



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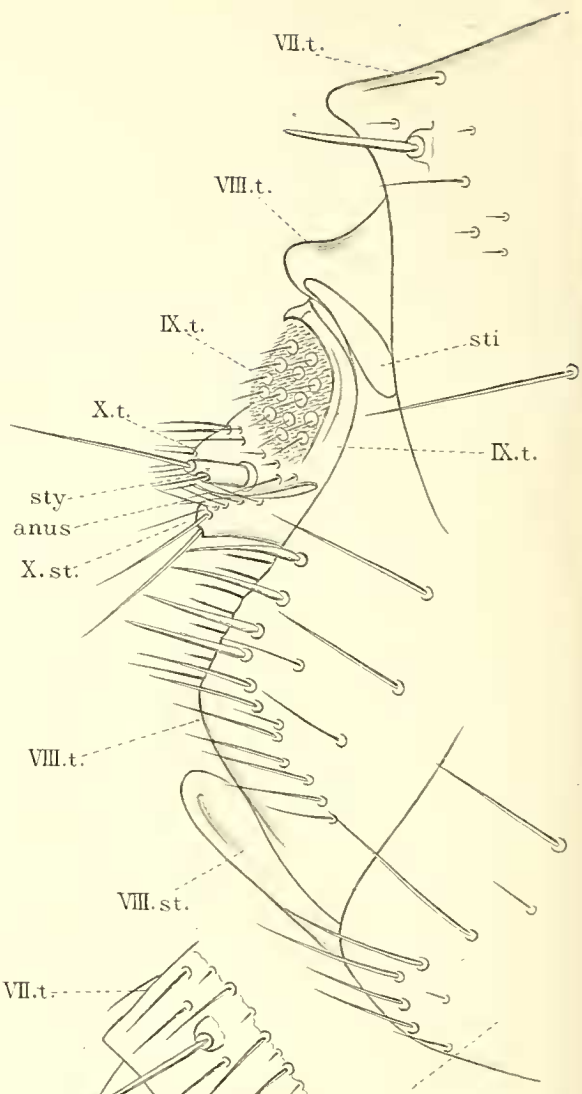

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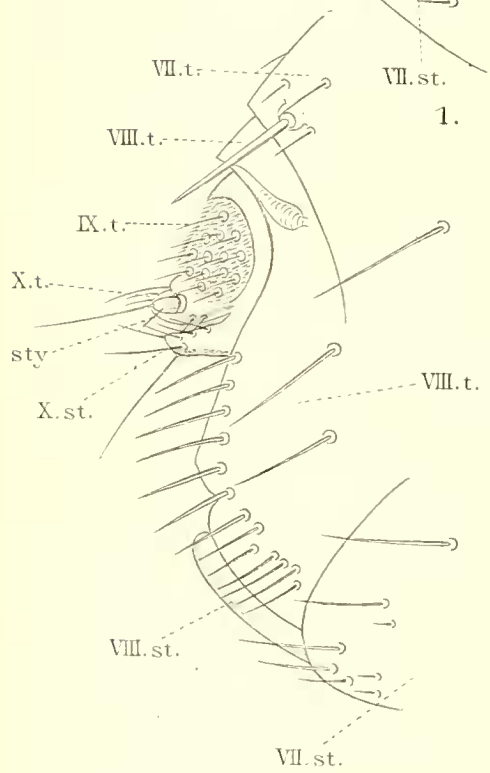

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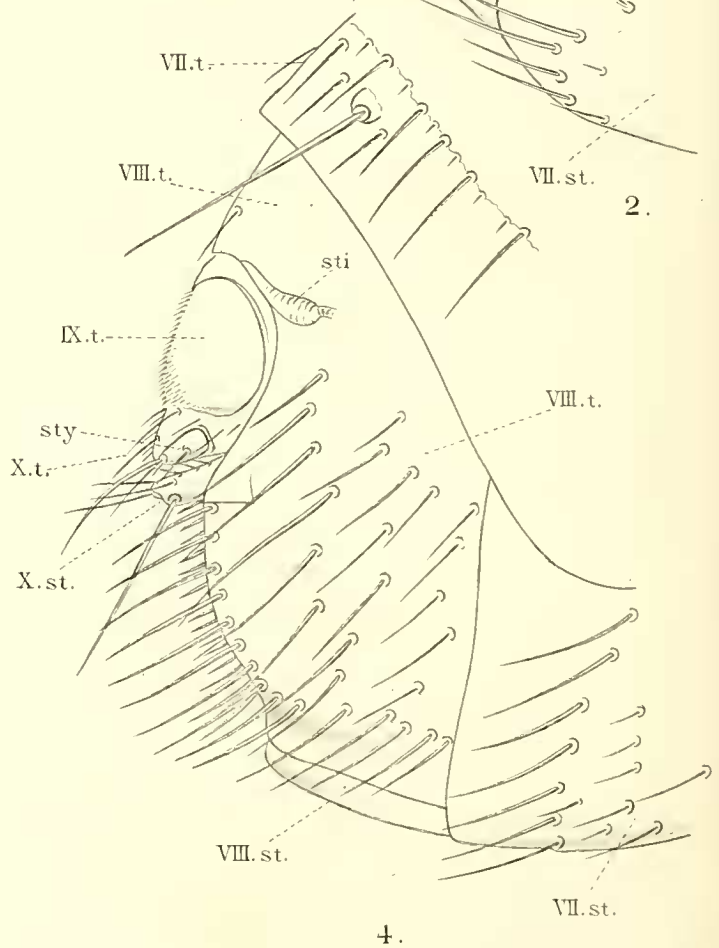

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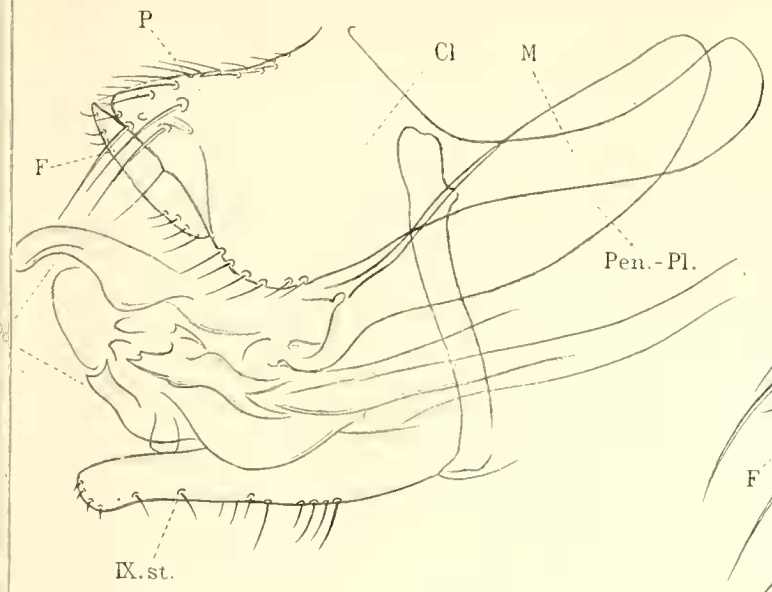

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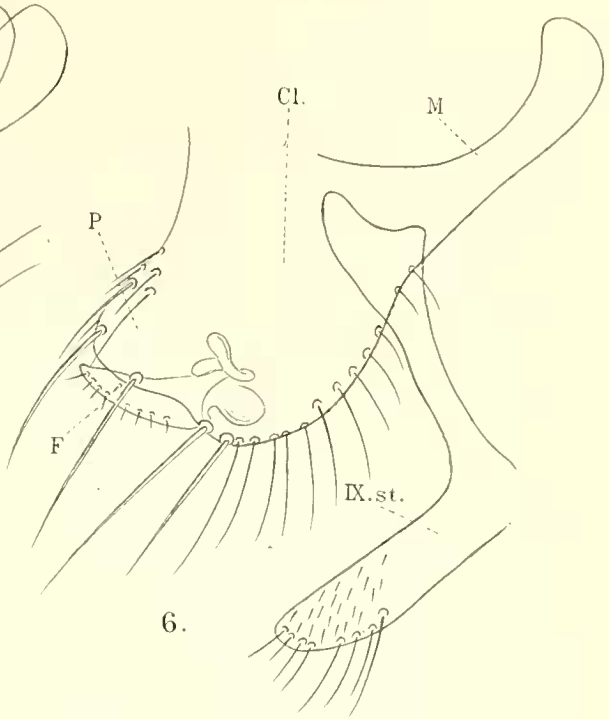

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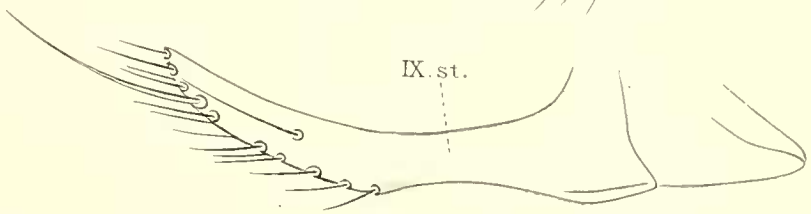

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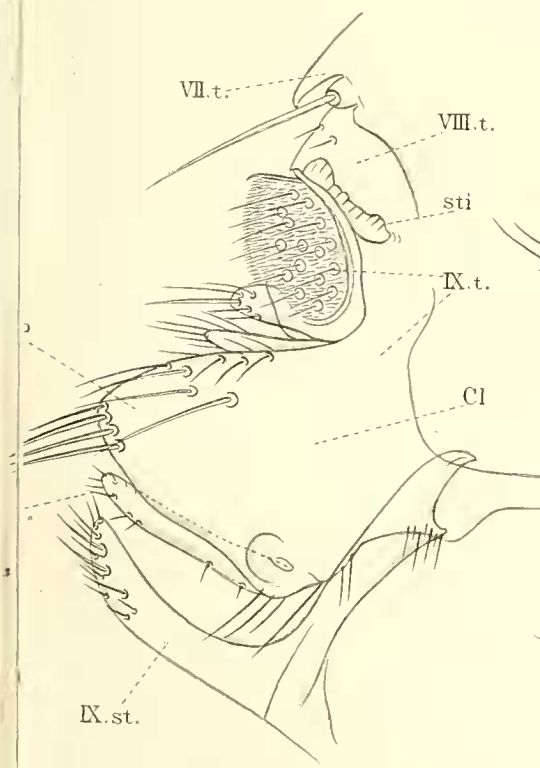

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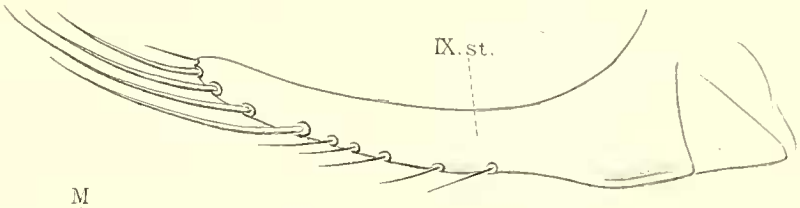

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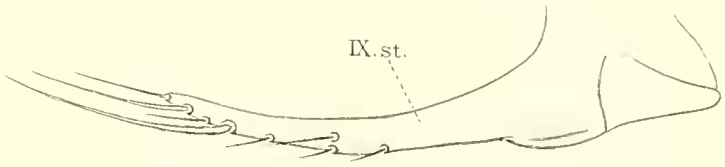

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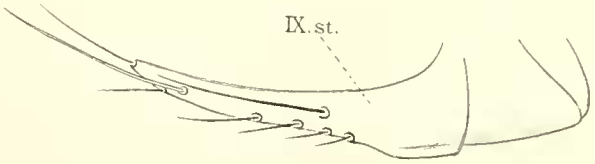

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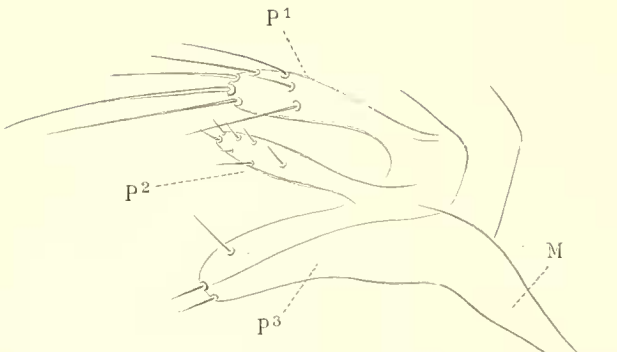
Lith.Anst.v.K.Wesser,Jena.



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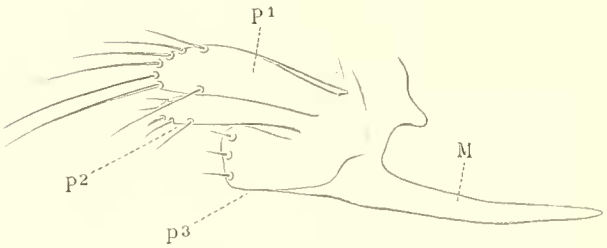

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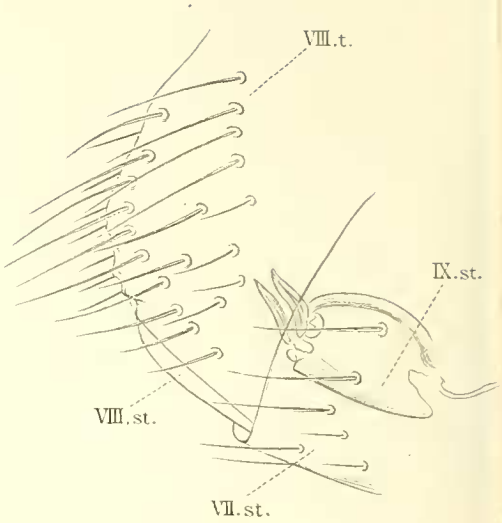

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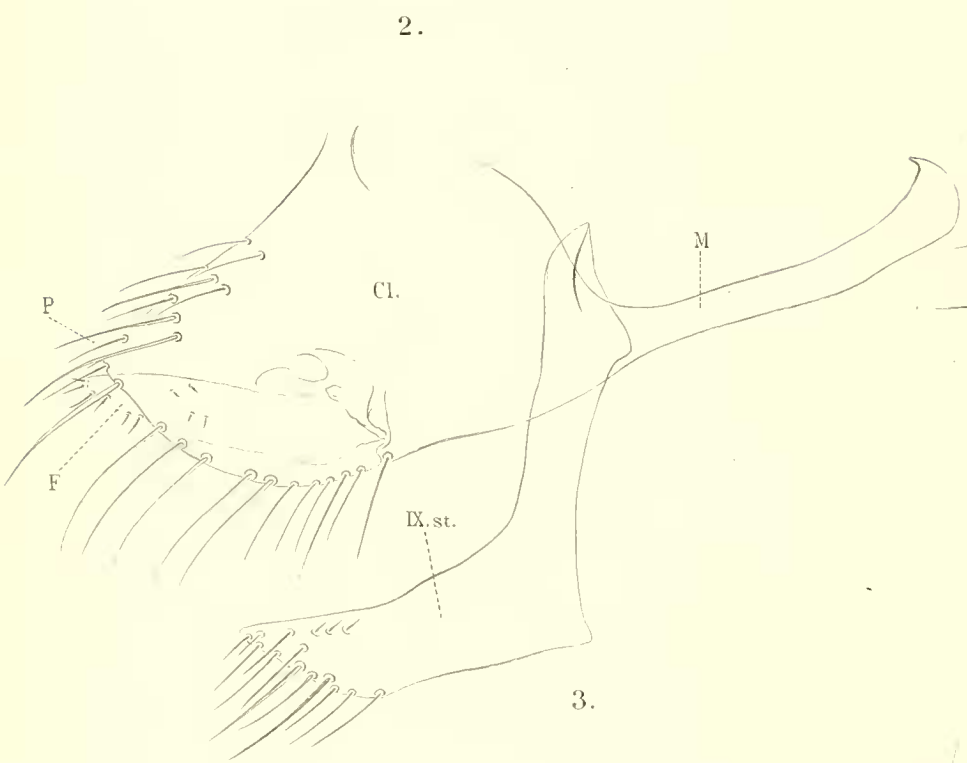

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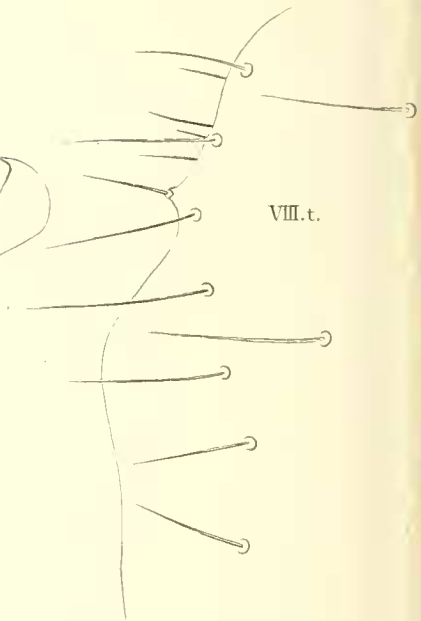

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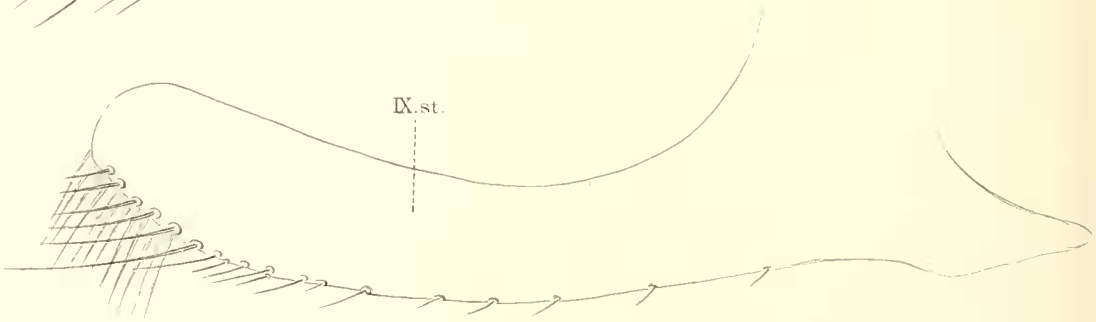

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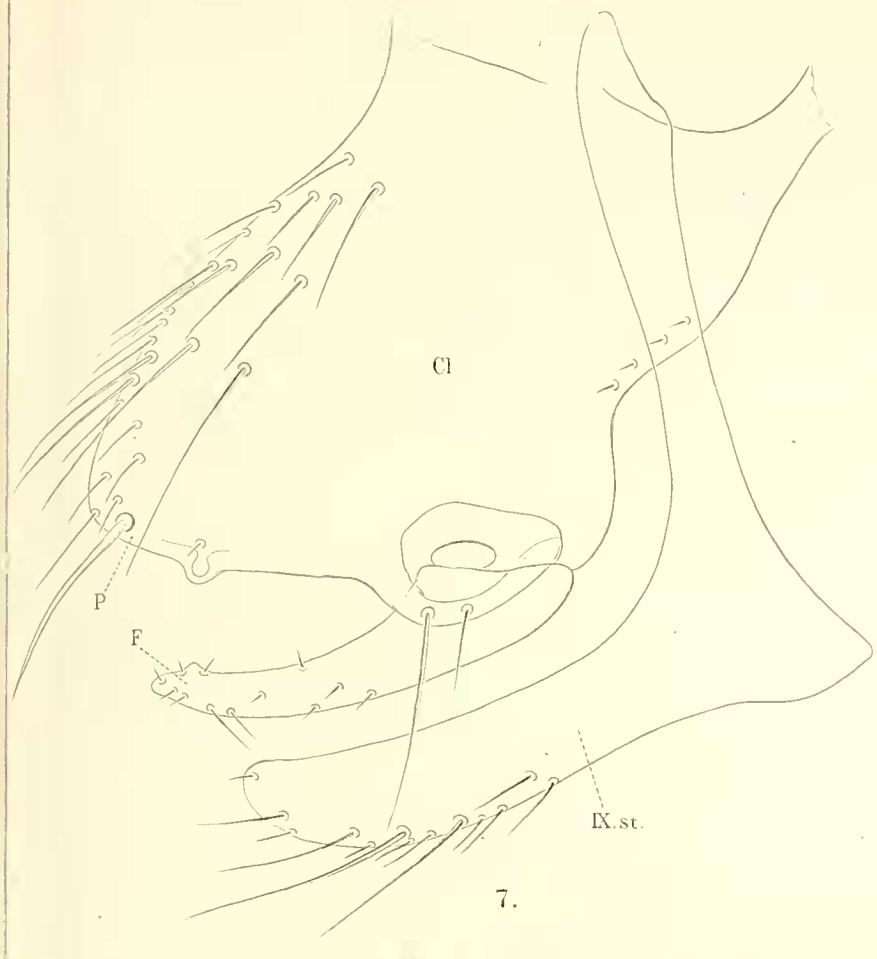

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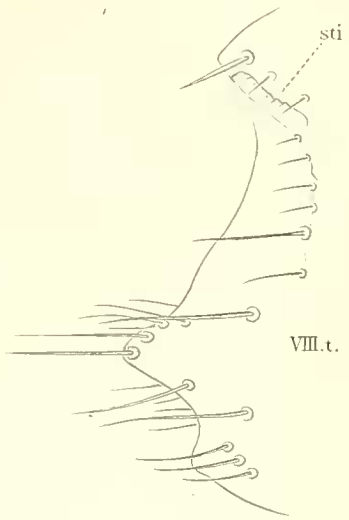

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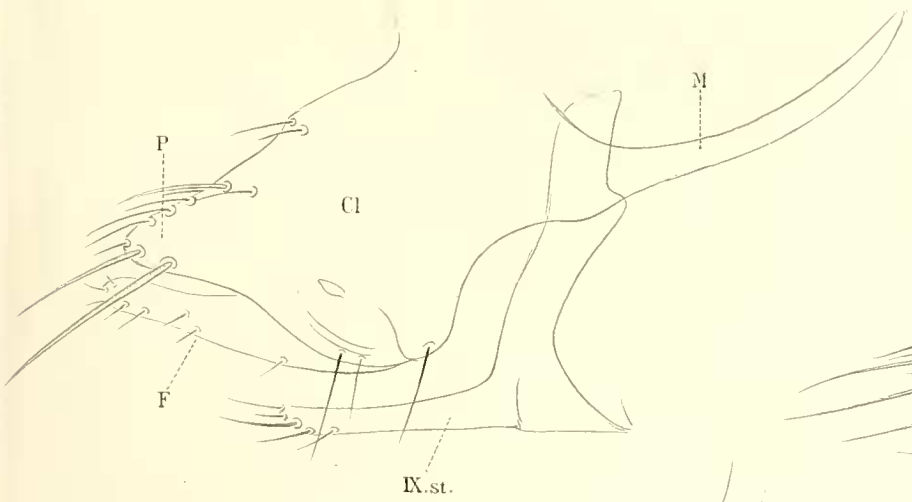

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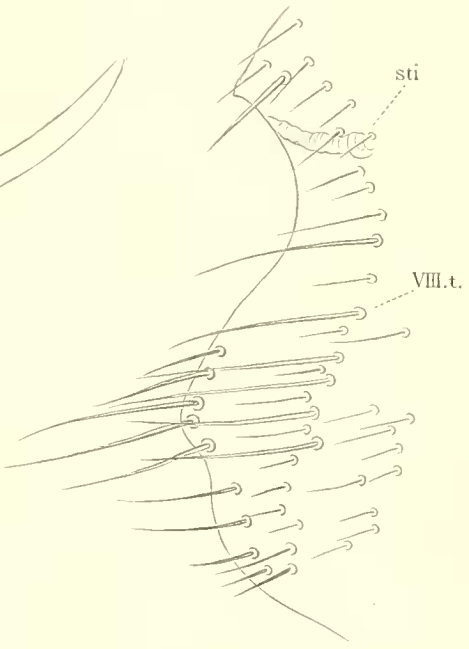

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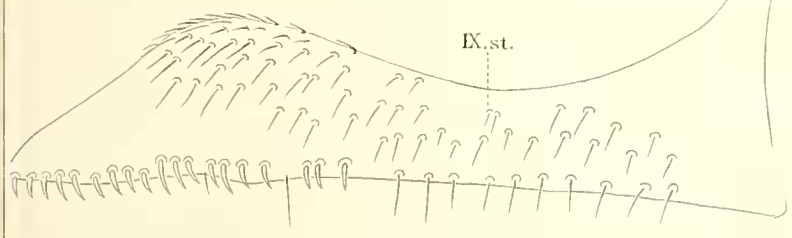

11.

Lith.Anst.v.K.Wesser,Jena.